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MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR FISCAL YEAR 19--ETC(U)
JUL 78 L S HANCOCK

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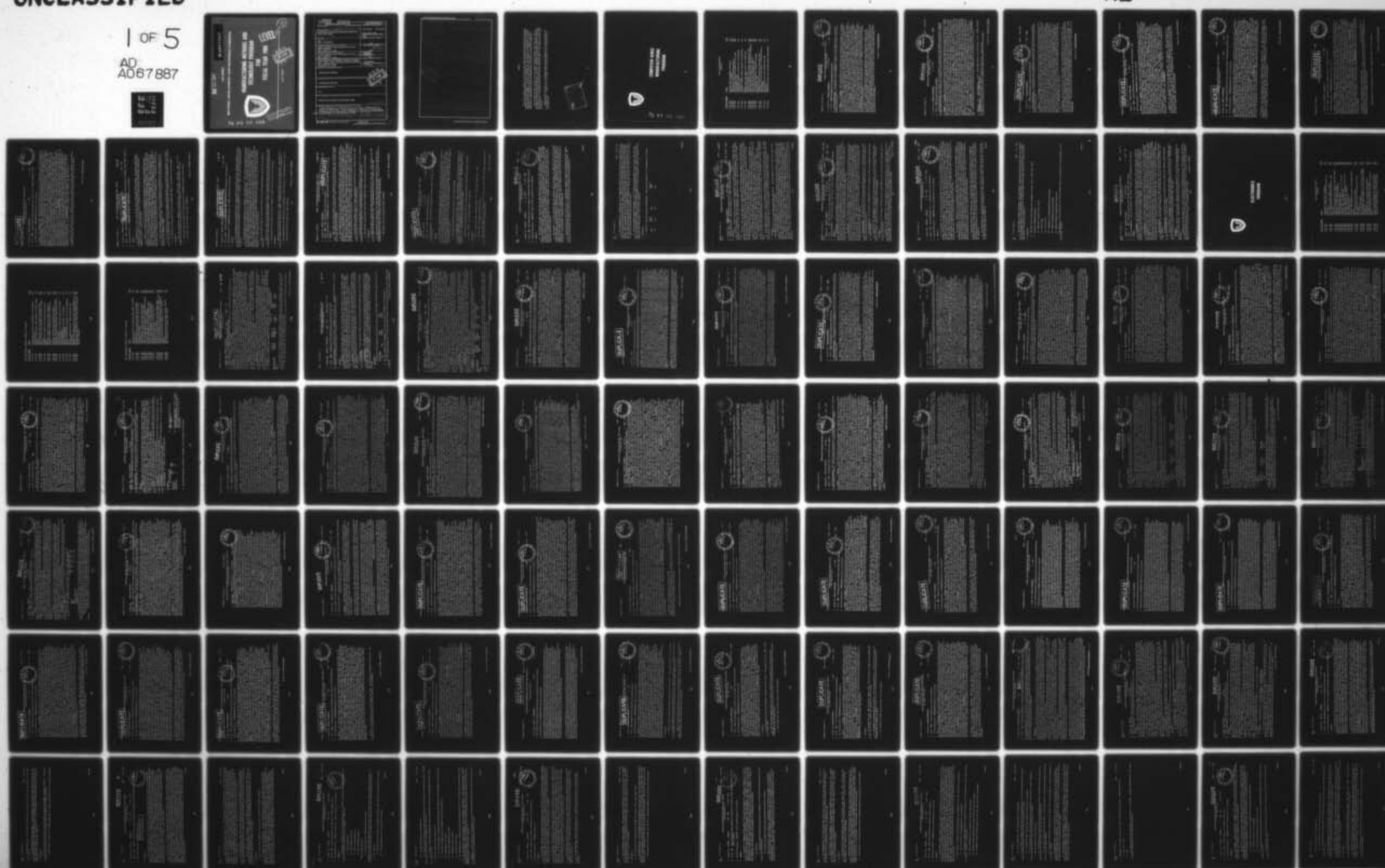

US ARMY

MATERIEL DEVELOPMENT AND READINESS COMMAND

MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR FISCAL YEAR 1980

JULY 1978

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Manufacturing Methods and Technology (MMT)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This document is a compilation of the P-16 Part I Summaries for the DARCOM FY80 MMT Program. It is assembled as a guide for the Manufacturing Technology Advisory Group (MTAG), ~~therefore~~ it is therefore divided into six sections which ~~corresponding~~ correspond to the Subcommittees of MTAG: the following Computer-aided manufacturing program; Electronics program; Inspection and test program; Metals program; Munitions Program; and Nonmetals program.

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PREFACE

This book contains a summary of the Fiscal Year 1980 Manufacturing Methods and Technology Program as it was submitted to the HQ, Department of Army by the HQ, US Army Materiel Development and Readiness Command. The book is divided into six sections corresponding to the subcommittees of the Manufacturing Technology Advisory Group (MTAG); i.e., metals, non-metals, electronics, computer-aided design and manufacturing, munitions, and test and inspection.

Each section includes the Part I of the project request (Exhibit P-16) which is used by the Army to describe the proposed work. The Part I identifies the problem, proposed solution, end products to be delivered, implementation plan, potential benefits and cost. In those cases where the project has application in more than one technical area, it is included in more than one section.

These projects are still in the planning stage and may change as they evolve through the Army budget cycle. Funding for the projects that are approved will not be available until 1 October 1979.

COMPUTER AIDED MANUFACTURING PROGRAM

2

FY80 CAD-CAM PROJECTS
08/02/78

PROJECT NUMBER	TITLE	COST
F 80 3005	Graphical Part Programming Evaluation	95
F 80 3035	Built-in Test Evaluator	250
F 80 3041	Elimination of Hard Copy Documentation	900
R 80 1018	Improved Manufacturing Processes for Dry Tuned Accelerometers (CAM)	380
R 80 1021	Computerized Production Process Plan for Machined Cylindrical Parts	240
R 80 1028	Optimized Computer Thermal Analysis of Hybrids and P.W.B.	200
R 80 3281	Manufacturing Technology Project for Silver-Zinc Guidance Batteries (CAM)	250
T 80 5080	Fabrication Methods for Aluminum Transmission Cases	150
T 80 5082	Flexible Machining System, Pilot Line for TCV Components	880
T 80 5091	Heavy Aluminum Plate Fabrication (Phase I)	420
1 80 7248	Closed Loop Machining T700 Mid Frame	500
5 80 6736	Tech Readiness Accel Thru Computer Integrated Manufacturing (CAM)	287
6 80 7707	Automated Process Control for Machining (CAM)	114
6 80 7949	Application of Group Technology to RIA Manufacturing (CAM Related)	155
6 80 7963	Group Technology for Fire Control Parts and Assemblies	299
6 80 8034	Manufacturing Shop Floor Feedback System (CAM Related)	84

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. F803005 (CORADCOM) 2. PA 5297 3. Cost: $956

4. Title: (MM&T) Graphical Part Programming Evaluation

5. Facility/Contractor: This project will be performed in-house by CAD-E/CAM Division, Technical Support Activity (official designation within CORADCOM not known at this time), and by competitively selected contractors.

6. Summary - (a) Problem - The state-of-the-art of Numerical Part Programming Languages is a dynamically changing environment. The introduction of Computer Aided Design (CAD) systems and the retention of computerized data bases has a profound impact on the methods by which this data is transferred to end item production. The traditional method for the transfer of design to production was for a numerical control part programmer to transfer data from an engineering drawing to a numerical control machining tape by use of a numerical control part programming language. This method typically required several iterations and, depending on the complexity of the part, could take from hours to weeks to program. (b) Solution - Some CAD systems have built-in computer programs to perform the numerical control part programming function at some level of proficiency. This project is to define the systems that have programming capabilities and to evaluate the degree of effectiveness by which they produce the numerical control part program and the efficiency of the program produced. (c) End Product - This project will produce an evaluation matrix of CAD systems, programming capabilities, control tape efficiencies, and part class versus system selection criteria. With this information DoD installations and agencies will have an effective source of data to select the appropriate system for their use. (d) Implementation - The results of this project will be disseminated to Government and industry by coordination with the Manufacturing Technology Advisor Group. Technical point of contact: Melvyn S. Kosmin, Autovon 995-4778/4940.

7. Economics: A formal economic analysis was not submitted since precise cost savings are not determinable. However, DoD spends over 16 Billion dollars per year on numerical control and conventional fabrication processes. If an estimated 5% of this capital spent is used on numerical control programming, this would amount to 80 million dollars per year. Assuming a 10 percent savings is realized in NC programming processes as a result of CAD system evolution then 8 million dollars annually will be saved. The precise savings are estimated but the magnitude of the potential savings are realistic and realizable. The execution of this project will not have a significant impact on the quality of the environment.

Project No. F803005(CORADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)

RECEIVED 5 MAY 1978

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. F803035 (CORADCOM) 2. PA 5297 3. Cost: $250K

4. Title: MM&T for Built-in Test Evaluator

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive negotiated bidding with technically qualified sources and will be supervised by CORADCOM.

6. Summary: (a) Problem The use of Built-in Test (BIT) is being stressed by all three services for use during operators' and organizational maintenance to reduce cost and the need for skilled personnel in the field. Future Army electronic materiel will contain BIT within subsystems, modules, and even to the LSI/VLSI chip level. This BIT capability could be used to reduce production testing costs. However, prior to utilizing this BIT capability as part of the production test cycle, it will be necessary to certify the adequacy of the BIT capability to meet or exceed production test performance criteria. (b) Solution - Computer-aided test design (CATD) techniques will be used to evaluate the BIT capability within subsystems, modules, and/or LSI/VLSI chip level. The results of the CATD analysis will provide information about the adequacy of the BIT capability to detect: (1) faults within the BIT circuitry itself; (2) catastrophic faults within the total fault population of the system; (3) component variations which lead to fault tolerance build-up of system signal levels and/or timing; and (4) sensitive variations in calibrated system performance parameters. This information will provide a numerical basis for establishing the adequacy of the BIT capability to perform production testing. To accomplish the aims of this project, a multiyear program will be required. The first phase work will study non-complex BIT capabilities and their adaptability to CATD. The future years' work will be concerned with an increase in BIT complexity and will expand the techniques data base. Funds in the amount of $250,000 will be expended in FY-80 and $500,000 in FY-82, for a total of $750,000. (c) End Product - The end product of this effort will include a firmware/software test system consisting of a computer program for evaluating the BIT, a minicomputer, and an input/output terminal. (d) Implementation - A protype line demonstration to industry will be accomplished at the conclusion of the project.

7. Economics: (a) I. R&D Expenditures - FY-78: $159K (R&D Task No. 1L1 62779 AH 62), FY-79: $200K (Planned).
II. PEM Expenditure: FY-82: $500K (Planned).
(b) Results of the economic analysis indicate savings of $10.5 million - $13.2 million.
(c) Execution of this project will not have a significant impact on the quality of the environment.

Project No. F803035 (CORADCOM)

EXHIBIT P-16 (Pa...) DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: F803041(CORADCOM) 2. PA 5297 3. Cost: 900K

4. Title: (MM&T) Elimination of Hard Copy Documentation

5. Facility/Contractor: This project will be performed in-house by CAD-E/CAM Division, Technical Support Activity (official designation within CORADCOM not known at this time) and by competitively selected contractors.

6. Summary - (a) Problem - The production of ITDT documentation for training and maintenance information is expected to substantially increase the quantity of paper necessary for support of Army systems. For example, there will be on the order of 6000 pages of documentation on each turret alone of the Army's new main battle tank. The support and usage of such voluminous material poses a significant problem for field utilization. Applications of video disc and electronic display technologies are being pursued to deal with this situation. The problem occurs, however, in converting the ITDT information from the printed page format to one which is compatible with electronic display, whether digital or video. (b) Solution - Current R&D efforts have been initiated to deal with the conversion problem itself which will result in a methodology for format conversion. Electronic display technology will be utilized to minimize the problems of documentation manageability while increasing maintenance and maintenance training effectiveness. (c) End Product - This project will determine and produce software/hardware necessary to implement the process for the reformatting of paper format ITDT information to electronic display format as prescribed by the conversion methodology. (d) Implementation - The results of this project and a computer program will be disseminated to industry and other Government agencies.

7. Economics: No known efforts have been expended by the Government in this project area. No additional funding for this project is anticipated. Expected cost savings as a result of the use of electronic display technology have been shown (Draft ROC, dated 28 Feb 78 for an "Electronic Information Delivery System (EIDS)") with regard to initial production and reproduction costs. It is estimated that approximately 7200 pages of paper documentation could be stored on an electronic system for the same cost as it would take to produce a single sheet of paper and in a fraction of the storage area. The execution of this project will not have a significant impact on the quality of the environment.

Project No. F803041(CORADCOM)

EXHIBIT P-16 (PART I) DUPLICATE DATE: 1 July 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R2)

1. Project No. R801018 (MIRADCOM) 2. 2597 3. Cost: 380

4. Title: MM&T - Improved Manufacturing Processes for Dry Tuned Accelerometers (CAM)

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: There is a need to establish manufacturing methods necessary to increase yield and reduce cost of dry tuned accelerometers for use on the Strapdown Inertial Guidance Demonstration (SIG-D) and Long Range Guided Missile (LRGM) Programs. The present method used to manufacture the dry flexure supports for the acceleration sensitive element consists of several distinct machining operations on a lathe. The mechanical setup and running time for each operation is excessive. The risk of making a catastropic error during a final machining operation is always present. Checkout is not automated. (b) Solution: The use of electrical machining processes such as electrical discharge machine (EDM), electrical discharge wire cutting (EDWC), electrochemical machining (ECM), and electrochemical grinding (ECG) will allow automated machining of the complex dry flexure supports based on a programmed process. A manufacturing optimization effort will be performed by conducting cost (and yield) tradeoffs versus electrical impulse rate, gap between tool and workpiece, type of dielectric fluid, and cutting tool shape. The process will be totally automated to allow use of low skilled operators to run more than one machine at a time. A more novel approach will be to adjust the tooling to cut more than one flexure support at a time. (c) End Products: End products of the project will include hardware - accelerometers flexure supports, assembled accelerometers; and software - manufacturing data, computer program process. (d) Implementation: A pilot - production line will be established and contractor - operated for dry tuned accelerometers.

7. Economics: (a) This project will cost $380K for FY80. Prior R&D Funds - $225K, DA Project No.'s 1L162302A214 and 1L362303A214. (b) The savings realized by the completion and enactment of this project would be $1,800,000 over a five year period. In large quantities without MM&T, the cost of the dry tuned accelerometer is $1400. With MM&T, the cost can be reduced to $1100. (c) Execution of this project will not have a significant impact on the environment.

Project No. R801018 (MIRADCOM)

DUPLICATE

EXHIBIT [illegible] (PART [illegible])

DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R801021 (MIRADCOM) 2. 2597 3. Cost: .40M

4. Title: MM&T Computerized Production Process Planning (CPPP) for Machined Cylindrical Parts

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Machined cylindrical components are a significant cost driver for missile systems and other DOD procurements. Manual methods predominate in production process planning for these components. This results in high process planning costs and forfeits production cost savings that could be obtained through process standardization and optimization. (b) Solution: This program would develop a computer software system for process planning of machined cylindrical parts. The system will be manufacturer-independent, so that it can be used by a broad spectrum of industry producing missile components and other DOD items. Manufacturer-independence will be achieved through the technique of "process decision modeling" in which manufacturing rationale of a workshop is expressed in an English-like form for execution by the software system. (c) End Product: This project will produce a manufacturer-independent computer technology for cylindrical parts process planning. Computer software, technical reports, system documentation, user documentation, slide and motion picture presentations, and an industry demonstration will be delivered. . These deliveries will provide a CPPP technology that can be transferred to a broad spectrum of industry. (d) Implementation: After completion of this project, action will be taken to disseminate results to project managers, other commands, other services, and machining industry. Computer software and documentation will be made available to industry producing machined cylindrical DOD components.

7. Economics: (a) This project will cost .240M For FY80 and .250M for FY81. (b) Based on utilization of the system by 15% of industry producing machined cylindrical missile components, cost savings will be $.720M per year. If benefits for other DOD items are included, savings will be considerably greater. (c) Execution of this project will not have a significant impact on the environment.

Project No. R801021(MIRADCOM)

EXHIBIT P-16 (PART I)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

Date: 1 Jul 78

RECEIVED 5 JUL 1978

1. Project No. R801028 (MIRADCOM) 2. 5297 3. Cost: $.2M

4. Title: MM&T - Optimized Computer Thermal Analysis of Hybrids and P.W.B.

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: The trend in military electronics is for highly dense packaging techniques with an inherent increase in power dissipation and need for heat removal. This thermal stress of semiconductor and other components is directly related to component value drift and more importantly - reliability. There are a variety of computer programs available for use in thermal analysis of hybrids. Most of the very thorough programs, such as CINDA, are cumbersome and not well adapted for use with hybrid thermal analysis. Some of the others have questionable accuracy. "Burn-in" tests require high thermal stress for relatively short periods of time; however, there is a maximum temperature for semiconductor components that should not be exceeded. Hence, there is a great need for an optimized accurate, efficient, *standardized program that maximizes the programmer's* effectiveness. (b) Solution: Adapt and optimize the most effective program available for use in the manufacturing environment for proper selection of heat transfer techniques and materials. (c) End Products: This project will result in (1) a deliverable, optimized hybrid thermal analysis program in a widely used higher-order language; (2) technical reports on detailed theory of operation, test results of accuracy and program results; (3) a users manual that will allow ease of use. (d) Implementation: Project Managers will be notified of the availability of this software. Technical presentations and technical reports will be sent to appropriate technical societies.

7. Economics: This program will cost $.2M in FY80 Cost savings as a result of completion of this project will be primarily due to a reduction of test time and the expected increase in product reliability. The military uses several million hybrids and P.W.B.s a year and it is estimated that for hybrids alone a 20 percent savings can be achieved.

The execution of this project will not have a significant effect on the environment.

Project No. R801028 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

DATE: 1 Jul 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803281(MIRADCOM) 2. 2597 3. Cost: 250M

4. Title: MM&T - Manufacturing Technology Project for Silver - Zinc Guidance Batteries (CAM)

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Anodes and cathodes manufacturing for silver zinc batteries is still largely based on technology developed 20 years ago. Advanced process control technology has offered the opportunity to improve the present manufacturing. The major problem with present methods of manufacturing is the plate dimension control, contamination prevention, the assembly requirements, and the lack of final inspection. The batteries are required to supply a high current supply and short life span. With those ridgid requirements a process controlled method must be introduced. These requirements could all be controlled and tested by a computerized test center. (b) Solution: It is proposed to undertake a project to develop precise manufacturing methods including testing. The method proposed is a computer aided manufacturing process that through sensors can monitor each phase of manufacturing and test each phase before proceeding further. This computer aided method would greatly reduce the requirement for checking 20% of the batteries manufactured as a final test procedure, thereby, wasting these batteries. Elimination of final testing of one time operation of batteries would be a great cost savings and excel as high reliability and effective devices. (c) End Products: The end products would be (1) a pilot plant for the continuous production of Anode and cathode battery plates, (2) computer aided equipment for continuously monitoring and correcting plate manufacturing, (3) sensor based computerized test center to monitor complete manufacturing process, (4) computer based test center performing final acceptance testing with non-destructive methods, (5) technical reports giving results of all experiments and test runs, (6) all specialized hardware and software developed for this subject. d. Implementation: After successful completion of this project, action will be required to disseminate the results to all project managers, other commands, and other services.

7. Economics: This project will cost .750M over a period of 36 months, for FY80, FY81, and FY82. The potential savings are 1500K total. Execution of this project will not have a significant impact on the environment.

Project No. R803281(MIRADCOM)

EXHIBIT P-16 (PART I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

DUPLICATE

1. Project No. T80508C (TARADCOM) 2. DA 3197 3. Cost 150K

4. Title: MM&T: Fabrication Methods for High Strength Near Net Shape Aluminum Transmission Cases (CAM) (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be Selected

6. Summary:

a. Transmission cases are unique in that they are long thin walled castings. The sections used present difficulties in casting. Dimensional and metallurgical reliability variation from casting to casting results in additional assembly time and machining costs. Reliable net shape casting processes would reduce many expensive machining operations and costs.

b. Dimensional reproducibility will be established by instituting a program of interrelated process controls. Phase I (FY79) of the program established the configuration and dimensional factors that affect the variations in casting of transmission cases incorporating the typical design features. A basis for predicting statistically the variations to be expected in production castings was determined. Work on interrelation of control and metallurgical factors has been initiated. Phase II (FY80) will complete the evaluation of these factors. Emphasis on effect of introduction of reinforcing materials will be emphasized to establish reliability of production techniques for use of advanced materials. Production cases will be fabricated for laboratory and field trials to demonstrate the application of the data on a production run. A final report will be written.

c. Phase II will produce a technical report with information for adaptation of these techniques to production of all types of transmission cases. Information from this project will also be incorporated into the technical data package as needed.

d. At the completion of the project, changes will be initiated to the technical data package. The initial effort will be project funded. The process control method will be demonstrated to fabricators of these components.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. There was no R&D effort leading to this PEM project. PEM for FY79 - 325K; FY80 - 150K. It is not foreseen at this time that any additional cost will be required to develop the PEM project results.

b. The project has the potential for reducing costs of transmission cases by as much as 20%.

c. The project will not violate any safety standards.

Project No. T805080 (TARADCOM)

EXHIBIT P-16 (PART I)   PRODU...ION ENGINEERING MEASURES (PEM) ...OJECT   1 JUL 1978

RCS CSCRD-165 (R1

DUPLICATE

1. Project No. T805082 (TARADCOM)   P... ...97   3. Cost 880K

4. Title: MM&T: Flexible Machining Systems (FMS) Pilot Line for TCV Components (CAM) (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090, Contractor to be Selected.

6. Summary:

a. It is recognized that items manufactured in large numbers using mass production technology (automation) cost less per item than the same item produced in small quantities. Parts for tracked combat vehicles are rarely procured in quantities which permit the benefits of mass production to be realized. Thus, TCV parts are extremely expensive to produce.

b. The advantages of mass production can be brought to the production of items procured in medium size quantities (1,000 to 100,000 parts) by a concept known as a "Flexible Machining System". This concept, when employing computers and coupled with simplified mass production type tooling can introduce a level of flexibility which will enable it to handle a number of suitably selected similar parts with very nearly the same efficiency as is achieved in mass production. The Phase I effort (FY79) was coordinated with the contractor who has a prototype FMS system. This FMS system was observed to determine efficiency, problems in software programming and opportunities for system optimization. The Phase II effort (FY80) will continue software optimization and will produce generic specifications of software and hardware. Phase III will conclude the Phase II effort and examine adaptive control systems to enhance FMS performance. A final report will be written.

c. The end product of Phase II of the project will be the generic specifications required for procuring an FMS system.

d. Phase III will verify the optimized software developed in the prior phases and will identify adaptive control technology that could further improve FMS performance. Project results will address second facilitization for XM-1.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. FMS has not received any R&D effort. Project funding under PEM for FY79 required 440K. FY80 fund requirements will be 880K and for FY81, funds will be 880K. No additional funds will be required for implementation.

b. The implementation of an FMS system can be expected to reduce the costs of items machined by at least 55%.

c. This project will not violate any safety standards.

PRODU..ION ENGINEERING MEASURES (PEM) ..OJECT
RCS CSCRD-165 (R1)

11 JUL 1978

DUPLICATE

1. Project No. T805091 (TARADCOM) 2. PA 319 3. Cost 420K

4. Title: MM&T: Heavy Aluminum Plate Fabrication (Phase I)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be Selected

6. Summary:

a. Many combat and tactical vehicle hulls and their components are fabricated from large thickness aluminum plate. The problem being addressed is the high labor content in cutting heavy aluminum plate to given contours and joining such pieces by welding.

b. The proposed solution is to cut heavy aluminum plate rapidly by the plasma arc process using numerical control and to establish rapid joining procedures for the thick plate after plasma cutting by using electron beam, gas metal arc, or gas tungsten arc welding. Mutations of these welding processes have been designed in private industry for the welding of thick aluminum plate. Phase I of the project will determine optimum procedures for plasma cutting of thick aluminum plate. Process parameters will be established for gas metal arc, gas tungsten arc and electron beam welding of heavy aluminum plate. A report will be written. Phase II will consist of cutting aluminum plate, welding a typical full-scale vehicle structure, subjecting this structure to simulated service, and writing weld procedures and specifications. A final report will be written stating the results of the project.

c. The end product of Phase I will be a report, procedures and specifications for improved and less labor-intensive methods of cutting and welding of heavy aluminum plate.

d. Briefings and demonstrations in conjunction with the dissemination of the final report to all interested governmental and private agencies will assure implementation at the earliest possible date.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. There have been no previous government sponsored R&D efforts in this area. Project funding under PEM will be 420K for FY80 and 180K for FY81. No PEM implementation costs are foreseen at this time.

b. The selection of improved and cost effective cutting and welding processes for heavy aluminum plate established by the project is expected to reduce fabrication costs by 30%. This savings in time and monies will provide benefits in the form of reduced lead times and improved scheduling.

c. This project will not violate any safety standards.

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1 JUL 1978

RECEIVED 6 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (RI)

1. Project No. 1807248   2. PA: 1497   3. Cost: 500

4. Title: MM&T - Closed Loop Machining T700 Mid Frame

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertonw, MA 02172, and contractor to be selected.

6. Summary:

a. This project will develop machine sensing using linear transducers that will automatically compensate for any deviation in numerical controlled (NC) programmed plan, thereby reducing production costs. The system will automatically make tool corrections and feed back measured dimensional data by integrating automatic inspection with NC machining via the use of a computer with accuracy and repeatability of .0002 inches. Upon completion of the operation, a print out of actual part size for quality records could be made. GE is using a transducer system for two axis measuring called an "Omniducer." This will be modified and incorporated into T700 machine system.

b. Prior R&D was performed by General Electric with internal funding.

c. The requirements on the T700 engine is to machine the mid-frame. The mid-frame has 22 diameters with tolerances ranging from ± .00025 to ± .001 inches. These tolerances result in high machining, rework and inspection costs. The application of closed loop machining will reduce these. The proposed system will be adaptable to all turbine engines including the 800 HP engine.

The end product of this effort will be a closed loop system for machining jet engine components.

d. Project Liaison: Mr. Kornitzky, DRXMR-PT, AV 955-3524.

7. Economics:

a. This is a three year effort totaling $1228-- FY79 - 423K, FY80 - 500K, FY81 - 305K.

b. The R&D effort was funded by private industry.

c. The successful completion of this project will decrease the costs of the T700 engine used on the Black Hawk & YAH64 (See Inclosure I, Economic Analysis).

Project No. 1807248

EXH P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5806736 (ARRCOM) 2. PA: 4250 3. Cost: $287

4. Title: MMT, Tech Readiness Accel thru Computer Integrated Mfg (TRACIM) CAD/CIM

5. Facility/Contractor: ARRADCOM, Dover, NJ and contractors to be selected

6. Summary

a. The problem: The lead time required to bring ammunition production (PEP) lines up to mobilization maximum is intolerably excessive. This is attributable, to a large degree, to non-availability of manufacturing technical skills, including engineers, technicians and particularly toolmakers, and machinists. The Department of Labor forecasts the critical shortage of toolmakers and machinists will be almost twice as serious by 1980. Additional and significant delay factors include the readiness of complete and up-to-date data on the item description, manufacturing processes, tool designs, equipment, facilities, machine spare parts, material requirements essential personnel.

b. The solution: It is not expected that the technical skills shortage will ameliorate and is more likely to grow much worse. The development and implementation of a Computer Integrated Manufacturing (CIM) System involving interactive graphics and numerical control machine tools will significantly reduce the requirement for highly skilled manufacturing craftsmen. Also, a computer data bank based on Group Technology techniques and maintained in a ready status will provide management and engineers immediate access to the very latest data required for a rapid build-up to maximum planned schedules.

c. The end products of this project are: A comprehensive Computer Integrated Manufacturing (CIM) System will be developed and demonstrated on samples of ongoing metal parts and items in the planning stage. The system will be suitable for application to the entire spectrum of ammunition design/manufacture.

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d. The implementation: Introduction of the techniques generated by this project will significantly cut lead time for active and mobilization PEP lines. TRACIM is a total technology which will require an extended time for complete realization and involve significant changes from conventional approaches to manufacturing. However, short term phases will be developed, demonstrated and made available for installation. The second and third year efforts are planned to accomplish these objectives. Fourth and future year efforts will provide the necessary modification and expansion of TRACIM for technology transfer and application to all aspects of ammunition systems engineering and manufacturing.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. This is a four year project totaling $683. PEM project funding for FY is summarized as follows:

FY76	Prior FY78	FY79	Present FY80
40	100	256	287

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EXHIBIT P-16 (Part 1)
8152

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

DATE: 1 Jun 78

1. Project No.: 6807707 (ARRCOM) 2. PW,A 3297 3. Cost (Thous): $114
4. Project Title: MM&T: Automated Process Control for Machining (CAM)
5. Facility/Contractor: Rock Island Arsenal, IL 61299; and Contractor(s) to be selected
6. Summary:

a. Problem. Present control in selection and application of machining operations is limited, and cost estimation of machining is slow and inaccurate. Similarly, control of machining parameters from, and through, prototype, planning, pilot, and mass production machining is limited. New controls are required to reduce costs.

b. Solution. This is the second of a two-year program following computerization of the Machining Data Handbook and design of process selection, comparison and cost estimation sub-systems in the first-year effort. The sub-system computer programs will be written complete with storage matrices. The sub-system matrices will be integrated; and the total system will be tested and implemented at Rock Island Arsenal with continuous feedback between planning, cost estimating, scheduling and machining operations.

c. End Products. A final report with computer programs will be included as part of the implemented system to provide manufacturing personnel with readily usable machining process performance standards for size and finish tolerances required in machined weapon components, and to augment shop loading and control by providing more accurate estimates of machining times required, with feedback of time actually used.

d. Implementation. Part of this system will be implemented during the project work at Rock Island Arsenal. Planners and NC programmers will be given the data and guidelines as completed. Complete implementation will be made with repetitive feedback of data in one to two years. No additional direct costs are anticipated.

e. Environmental Assessment. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written environmental impact assessment.

7. Economics:

a. There have been no preceding Government R&D efforts. The PEM project cost for the first year, FY77, is $105,000 and the requirement for FY80 is $114,000.

b. Quantifiable benefits, based on estimated cost-savings in man-hours presently spent by planners, programmers, foremen and machinists in the tasks of selecting machining processes, in estimating machining time and costs, and in making machining changes and adjustments, are $100,000 per year. This is based on an estimated 90% reduction in time required for these personnel who spend about 2% of their time in performing these tasks. However, equal or greater indirect benefits are expected through increased efficiencies in machining and scheduling. Non-quantifiable benefits will be: (1) improved selection of machining processes, (2) improved collection, storage and selection of machining parameters, (3) improved control of sizes and surface finishes, (4) quicker and more accurate machining time-and-cost estimating, and (5) reduced time and costs of machining.

DUPLICATE

EXHIBIT P-16 (Part I)
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

DATE. 1 June 1978

1. PROJECT NO. 6807949 (ARRCOM) 2. PW 3297 (NC) 3. COST. $155

4. TITLE. MMT: Application of Group Technology to RIA Mfg. (CAM related)

5. FACILITY/CONTRACTOR. Rock Island Arsenal, Rock Island, Illinois, and contractor(s) to be selected.

6. SUMMARY.

a. The problem. Current developments in the areas of classification and coding systems and group technology as applied to discrete parts manufacturing indicate substantial savings can be achieved by utilizing techniques which exploit the underlying sameness of parts to bring many of the benefits of mass production to small lot production. Reductions in manufacturing costs can be achieved from reductions in set-up time, tool inventory, and work-in process, and improvements in process planning, capital equipment selection, and cost estimating. These techniques are not currently being utilized by Rock Island Arsenal (RIA).

b. The solution. This funding program will bring the benefits made possible by classifying and coding production parts, and utilizing group technology, to RIA's manufacturing. In the FY79 project, the coding system procured by Picatinny Arsenal will be adapted to and installed on RIA manufactured parts, a computer terminal with access to the coding system and production data will be installed, and adaptation of application software initiated. The coding system and software procured by Picatinny Arsenal under a previous MM&T project is available to RIA at no cost. In this follow-on FY80 project, adaptation of application software will be completed and test applications performed. Based on the test applications, procedures for utilizing the system will be documented and the cost savings detailed.

c. The end products. The end products of this project funding program will be a classification and coding system installed on RIA's manufactured parts and the application software necessary to utilize this system to reduce total manufacturing cost.

d. The implementation. No additional implementation will be required to obtain the benefits from this project funding program.

e. The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written environmental impact assessment.

7. ECONOMICS.

a. Funds required for this project funding program are $127,000 for the FY79 project and $155,000 for this follow-on FY80 project.

b. Benefits to the government will include reductions in manufacturing costs at Rock Island Arsenal accruing from reductions in tool inventory, set-up time, and work in process, and improvements in process planning, capital equipment selection, and cost estimating. Results of the economic analysis (Incl 1) indicate a Savings/Investment Ratio (S/I) of 13.7 and a Rate of Return on Investment (ROI) of 100%.

EXF 'T P-16 (Part I)
815.

DUPLICATE

RG

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6807963 (ARRCOM) 2. PW: 3297 3. Cost: $299

4. Title: MMT: Group Technology for F.C. Component Parts and Assemblies.

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected.

6. Summary:

a. The problem: The low productivity and increase cost of fire control manufacture can be attributed to inherent factors such as small lot size (prototypes one to six; production units fifty or less) and the varieties of component parts and assemblies. These factors create such difficulties as profileration of design/manufacturing data, long set-up times, uncertain through put times, high work-in-progress, etc. Thus, the ability to design fire control products to achieve required performance at minimum cost is becoming increasingly dependent on the capabilities of the manufacturing process. There is a rapidly growing need for improved communication and feedback between the manufacturing process and the design process, integrating them into a single system with resulting minimum unit cost and economical manufacture of small lots.

b. The solution: Adaptation of an optimization technology, group technology and subsequently computer-integrated manufacture to improve the manufacturing productivity of small batch size fire control manufacture of the varied mechanical, optical and electronic component parts and assemblies. The new manufacturing system will integrate the manufacturing/design processes for fire control via coding and classification of parts/assemblies, formation of groups of parts/assemblies and machine/assembly equipment groups, manufacturing process planning, manufacturing analysis, quick retrieval of designs, drawings and manufacturing plans, accurate cost estimation, better utilization of machine tools, and effective uses of NC machines.

c. The end products of this project are: The end products will be group technology for the economical manufacture/design of small lots of fire control component parts and assemblies consisting of a coding and classification system, manufacturing analysis software, process planning software, and a data retrieval system. FY79 effort concentrates on fire control component parts; FY80 will concentrate on fire control sub-assemblies and assemblies.

d. The implementation: The Group Technology System will initially be implemented in the fire control design/manufacturing areas of ARRADCOM and subsequently to other applicable areas. This system will be available to other interested agencies within DA.

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e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 July 1977, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $487 as follows: FY79 - $188, FY80 - $299.

b. Results of Economic Analysis:

(1) Decrease in Annual Cost by $1.2M

(2) ROI is 150%

(3) S/I is 15.63

(4) Integration of Design/Manufacturing Processes.

(5) Improved Communications and Feedback.

(6) Improved Manufacturing/Design Productivity.

c. The execution of this project will not have an adverse affect on the quality of the environment or violate safety standards.

6807963

DUPLICATE

EXHIBIT P-16 (Part I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE. 1 June 1978
8152 RCS CSCRD-165 (R1)

1. PROJECT NO. 6808034 (ARRCOM) 2. PW 3297 (NC) 3. COST. $84

4. TITLE. MMT: Manufacturing Shop Floor Feedback System (CAM related)

5. FACILITY/CONTRACTOR. Rock Island Arsenal, Rock Island, Illinois, and contractor(s) to be selected.

6. SUMMARY.

a. The problem. The current worn condition of Rock Island Arsenal's (RIA's) factory data collection terminals and the limited capacity of the recording central processing unit prohibit effective support of portions of RIA's new production control system (PASLACS). The current CPU cannot support the interactive terminals required for direct control of material movement, equipment utilization, and labor efficiency.

b. The solution. This project funding program will design and install a pilot shop floor feedback system. This FY80 project will provide for system design while a follow-on FY81 project will provide for installation and debugging of a pilot system. An FY82 PIF project will expand the system from pilot to an operational status. The system will use shop floor and shop office input/output terminals to interact with the PASLACS manufacturing data base. It will allow authorized users to input information and make changes to the data base and to receive up-to-the-minute information from the data base. Typical uses will include allowing Methods & Standards personnel to directly input new standards, foremen to check equipment and labor utilization, dispatchers to input and receive material movement information and Quality Assurance personnel to input and receive inspection information.

c. The end products. The end products of this funding program will be an installed and debugged pilot shop floor feedback system, including central processing unit, auxillary data storage, input/output terminals, and system software.

d. The implementation. An FY82 PIF project will expand the pilot shop floor feedback system installed during this PEM project to an operational system.

e. The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written environmental impact assessment.

7. ECONOMICS.

a. PEM funds required for this project funding program are $84,000 for this FY80 project and $296,000 for the follow-on FY81 project. Additionally $1,090,000 for equipment will be included in an FY82 MOD Project #6828128.

b. Benefits to the government will include reductions in manufacturing costs at RIA accruing from the control made available to first line supervisors, and manufacturing planning personnel, and reductions in data processing equipment maintenance costs. Results of the economic analysis (Incl 1) indicate a Savings/Investment Ratio (S/I) of 1.78 and a Rate of Return on Investment (ROI) of 26%.

ELECTRONICS PROGRAM

FY80 ELECTRONICS PROJECTS
08/02/78

PROJECT NUMBER	TITLE	COST
E 80 3605	Transcalent (High Power) Transistor	61
E 80 3716	Production of Kocite (R) Derived Electrodes for Fuel Cells	238
E 80 3752	195 KW Military Power Quality Inverter	648
F 80 3024	Metal Oxide Threshold Switches (MOTS) for NEMP Protection	225
F 80 3032	Connector Terminated Stripe Geometry Injection Lasers	400
F 80 3040	Compatible AC Gas Discharge Display	1500
F 80 3041	Elimination of Hard Copy Documentation	900
H 80 3009	10 Micron Waveguide Lasers	600
H 80 3010	Millimeter-Wave Sources for 60, 94, and 140 GHZ	900
H 80 3012	Intra-red Source for AN/ALQ-144	285
H 80 3018	Production Techniques for 1 Megawatt HELS Switch	620
H 80 3019	High Energy Density P Lse Capacitor	360
H 80 3020	Fast Risetime SCR Switch	250
H 80 3023	Tubular Plasma Panel	550
H 80 3025	Low Cost Intraconnection System for Microwave Power Transis	500
H 80 3026	High Pressure Oxide IC Process	1100
H 80 3028	High Power X-ray System for Integrated Circuit Lithography	500
H 80 3031	10.6 UM CO2 Tea Lasers	550
H 80 3501	Third Generation Photocathode on Fiber Optic Faceplate	750
H 80 3502	Improved Piber Optic Inverter for 3rd Generation Image Intensifiers	280
H 80 3503	Holographic Optics for Night Vision Goggles	700
H 80 3504	Chalcogenide Glass Infrared Lens Blanks	245
H 80 3505	Automated Techniques for High Contrast Cathode Ray Tubes	245
H 80 3507	Low Cost Molded Packaging for Hybrid Electronics	240
H 80 3508	Ceramic-metal Substrates for Hybrid Electronics	315
H 80 3510	Transducer Process Technology for MW Delay Lines	250

FY80 ELECTRONICS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
H 80 3511	Fabrication of Submicron Photomasks for Integrated Circuit Devices	525
H 80 9563	Miniature High Voltage Power Supplies for Night Vision Goggles	600
H 80 9588	Third Generation Low Cost Image Intensifier Tubes	900
H 80 9897	Surface Acoustic Wave Resonator and Reflective Array Devices	300
R 80 1023	Digital Fault Isolation for Hybrid Microelectronic Modules	300
R 80 1024	MM&T Radio Frequency Stripline Hybrid Components	128
R 80 1028	Optimized Computer Thermal Analysis of Hybrids and P.W.B.	200
R 80 1030	Auto Test, Mounting, and Stacking of Locasert	229
R 80 1031	Eliminate Gold on Printed Wiring Board Edge Contacts	230
R 80 3081	Production of Radar Monopulse Seek Using Print Circuit/ Strip Technique	150
R 80 3139	Production Methods for Millimeter Seek for Terminal Homing Application	350
R 80 3186	Improved Manufacturing Processes for Infrared Indirect Fire Seekers	500
R 80 3189	Improved Manufacturing Processes for the CO2 Beamrider Optics	375
R 80 3214	Injection Molding Electric Cables Connectors with Polyurethane	400
R 80 3241	Automate X-ray Readout and Provide 3D X-ray Capability	600
R 80 3254	MM&T Low Cost Semi-flexible Thin Film Semiconductors (CAM)	425
R 80 3263	Manufacturing Technology for Print Wire Boards Utilizing Leadless Components	250

FY80 ELECTRONICS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
R 80 3267	Production Process for Removing Epoxy Smear in Plated Through Holes	200
R 80 3411	Manufacture of Non Planar Printed Circuit Boards	385
R 80 3427	Improved Manufacturing Technology for the Multi-environment Act Seek	450
R 80 3435	Simplification of High-Power Thick Film Hybrids	350
R 80 3436	Ceramic Circuit Boards and Large Area Hybrids	250
R 80 3444	Fully Additive Manufacturing for Printed Wiring Boards	200
R 80 3445	Precision Machining of Optical Components	400
1 80 7319	Digitally Addressable Multi-legend Display Switch	550
5 80 1003	Low Cost Molded Packaging for Hybrid Electronics	240
5 80 1005	Ceramic-metal Substrates for Hybrid Electronics	315
5 80 1345	Manufacturing Methods and Technology for the Biological Warning System	450
5 80 4141	Effects of Long Idle Periods on Electrically Lines	510
5 80 4182	Process Improvements and Auto Test for RAAM, GEMSS, GATOR	438
6 80 8010	Production of Acoustic Microwave Filters (CAM Related)	148
6 80 8054	Optical Scratch and Dig Standards for Fire Control Systems	183
6 80 8080	High Speed Fabrication of Aspheric Optical Surfaces	202
6 80 8209	Pilot Production of Gradient Index Optics	193

DUPLICATE

EXHIBIT P-16 (Part 1) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE: 1 JUL 1978

RCS CSGLD-1125 (1)

1. Project No: E803605 (MERADCOM) 2. PA: 5397 3. Cost: 61.0K
4. Title: (MM&T) - Transcalent (High Power) Transistor
5. Facility/Contractor: Commercial sole source to RCA Electronic Productions Division, Lancaster, PA. The effort will be monitored by MERADCOM.
6. Summary: a. Problem - The development of mobile, high power military power conditioners to support the SLEEP ROC and Draft LOA for Military Power conditioners requires reliable, lightweight, small volume, low cost, high power transcalent transistor devices. MERADCOM has completed development of a transistor which is a uniquely packaged device consisting of interdigitated transistor and ballast resistor silicon wafers sandwiched between two integral heat pipes. The transcalent approach results in a transistor which combines high current and high voltage characteristics in a single device which is much more compact than currently available devices. Two critical manufacturing problems were identified: alignment of the transistor wafer with the ballast resistor wafer, and quantity production of interdigitated wafers. These critical manufacturing problems must be solved to consistently produce devices meeting design specifications economically.

b. Solution - Specific processes will be developed to produce in quantity interdigitated silicon wafers. Production techniques will be developed to achieve the critical alignment of the ballast wafer with the transistor wafer and maintain alignment during final assembly operation. Processes required highly skilled personnel will be converted to conventional production methods.

c. End Products - The end products are an up-to-date technical data package to enable economical fabrication of high power transcalent transistor for military power conditioners, interim and final reports, and sample quantities of the high power transcalent transistor to prove out the new manufacturing process.

d. Implementation - Low cost devices will be possible from a quantity production process. The devices will be used in military power conditioners and other solid state applications to support fuel cell systems and mobile electric power requirements. The technical Point of Contact (POC) is Mr. F. G. Perkins, Autovon 354-5724.

7. Economics: a. The costs of this program in thousands of dollars are (estimates are base year FY78 inflated in accordance with DARCOM Letter, DRCCP-ER, 28 December 1977, subject: Inflation Guidance):

APPROPRIATION	PRIOR YR (ACTUAL)	CURRENT YR (ACTUAL) 78	FUTURE YRS FY 79	(INFLATED/THEN YR) BUDGET FY 80	FY 81
OPA	0	50	465	61	0
RDT&E	-	-	-	-	-

b. The effort is to produce a highly reliable, lightweight, high power transcalent transistor in a production line process for military power conditioners with increased yield reliable reproduction, and highly reduced cost. The per unit cost will be reduced at least 85%.

c. The anticipated project will not have any adverse effects on environment or violate safety standards.

EXHIB P-16 (Part 1)

PRODUCTION ENGINEERING MEASURES (PEM)
RCS CSCRD-165(R1)

1 JUL 1978

1. Project No. E803716 (MERADCOM) 2. Code: 5397 3. Cost (Thous): 238.4

4. Title: MM&T - Production of Kocite^R Derived Electrodes for Fuel Cells

5. Facility/Contractor: Cognizant Activity: MERADCOM, Ft. Belvoir, VA. Suggested Contractors: Universal Oil Products, Inc. as catalyst supplier to competitively selected prime contractor.

6. Summary:

a. Problem - The platinum required in fuel cell systems has been a major cost item in the past. Recent development efforts have indicated that very low platinum loaded carbon based electrodes (Kocite^R) exhibit satisfactory performance and stability. These electrodes are currently prepared in small size and number where tight control of platinum loading and electrode reproducibility are possible. Presently this control cannot be maintained in the fabrication of large Kocite^R electrodes in production quantities.

b. Solution - The manufacturing problem can be resolved by applying new preparation techniques for the fabrication of large (5 x 15 in) Kocite^R derived electrodes. These electrodes will be evaluated for performance, lifetime and reproducibility of performance characteristics. Results will be factored into future fuel cell production.

c. End Products - A final technical report will provide manufacturing techniques for low cost Kocite^R fuel cell electrodes.

d. Implementation - This MM&T project will result in the reduction of the platinum loading of fuel cell electrodes from 2 gm/ft^2 to 0.3 gm/ft^2. This reduction of the noble metal content of electrodes will reduce their costs from $768/KW to $369/KW. For the total planned SLEEP procurement of 4,881 power plants (15,696 KW), this represents an electrode costs savings of 6.3 million. Project Engr: Dr. J.A. Joebstl, Autovon: 354-5309

7. Economics:

a. The costs of the program are (in K-dollars; base year FY78 inflated IAW DRCCP-ER letter of 14 Dec 76).

Prior Years		FY80	FY81
$0	OPA	$238.4	$124.2

b. The cost reduction is estimated to be 52% (a savings of $399/KW in FY78 dollars).

c. The anticipated project will not have any adverse effects on the environment and will not violate safety standards.

Project No. E803716 (MERADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD-1125 (1)

DATE: 1 May 1978

1. Project No.: E803752 2. PA: 5397 3. Cost: $648K
4. Title: (MM&T) - 1.5KW Military Power Quality Inverter
5. Facility/Contractor: Commercial sole source to Delta Electronic Control Corp., Costa Mesa, CA. The effort will be monitored by MERADCOM.
6. Summary: a. Problem - The development of mobile, lightweight, low cost, military power quality power plants for the Army to support SLEEP ROC and Photovoltaic applications requires reliable, lightweight, small volume, low cost, efficient inverters to provide military quality AC power. MERADCOM has developed a 1.5KW military power quality inverter. This unit weighs 50 lbs, will provide selectable 60 or 400 Hz, single phase, 120 or 240 volt AC sine wave power as prescribed by MIL-STD-1332B, and it is a low cost design. The inverter will operate from a dc source (e.g., fuel cell, photovoltaic) between 30 and 50 volts. The manufacturing process will take a multi-phased assembly effort and establish an efficient production process. Presently the process is performed in a laboratory environment by skilled technicians. Specific problem areas are: (1) high quality assembly processes for mounting multiple transistor devices in close proximity (2) providing an efficient process to integrate electronic assembly and mechanical assembly processes to maintain a low cost finished product.

b. Solution - The low cost, high quantity production capability required for this device can be accomplished by determining the manufacturing and quality assurance methods required to produce this compact solid state equipment. This will involve taking a laboratory process and converting it into a manufacturing process that will eliminate processes requiring highly skilled personnel.

c. End Products - The end products of this project are an up-to-date technical package to allow controlled economical fabrication of 1.5KW military power quality inverters, quarterly reports, final reports and sample quantities of the 1.5KW military power quality inverter to prove the new manufacturing process.

d. Implementation - The investment will provide assurance that low cost, high quality equipment is available from a quantity production process. These production items will be used in military power plants to support fuel cell systems, photovoltaic systems and mobile electric power requirements. The technical Point of Contact (POC) is Mr. F. G. Perkins, Autovon 354-5724.

7. Economics: a. The costs of this program in thousands of dollars are (estimates are base year FY78 inflated in accordance with DARCOM Letter, DRCCP-ER, 28 December 1977, subject: Inflation Guidance):

APPROPRIATION	PRIOR YR (ACTUAL)	CURRENT YR (ACTUAL)	FUTURE YRS (INFLATED/THEN YR) FY 81	FY 82	FY 83
OPA	258	648	610	0	0
RDT&E	-	-	-	-	-

b. The effort is to produce a highly reliable, high efficiency (85%), lightweight (40 lb), small volume 1.5KW inverter to provide MIL-STD-1332B sine wave power in a production line process at highly reduced cost. The per unit cost will be reduced at least 80 per cent.

c. The anticipated project will not have any adverse effects on environment or violate safety standards.

EXHIBIT P-16 (Part I)

DUPLICATE

DATE: 1 May 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. F803024 2. PA 5297 3. Cost: 225K

4. Title: MM&T - Metal Oxide Threshold Switches (MOTS) for NEMP Protection

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive negotiations. The responsible activity for supervising the effort is CORADCOM.

6. Summary: (a) Problem - A nuclear Electromagnetic Pulse (NEMP) covers the broad spectrum from low frequency into the UHF band. It can be viewed as a single high powered pulse which will induce a harmful current surge in circuit elements which are not adequately protected. Circuit protection at high frequency or high data rates is not feasible with commercially available items because of their parasitic impedances, slow responses, nonlinear characteristics, or a combination of these properties. (b) Solution - Metal Oxide Threshold Switches (MOTS) have been developed as EMP protective devices at ECOM. Because of their subnanosecond response time, small off-state capacitance and high surge current capability, combined with small size and low projected cost, MOTS will provide the protection for high frequency and high data rate links which has not been feasible. (c) End Products - Compact MOTS in a strip lead package will be produced for retrofiting into existing coaxial connectors or other transmission line elements, and for placement within receiver housings (existing or new equipment). This effort, which is based on development work of ECOM will result in establishing production methods for high yield, low cost MOTS devices. (d) Implementation - A demonstration run of the pilot production to be established under this program will produce at least 1000 MOTS, fully tested. Technical Point of Contact: Gerhart Gaule'/AUTOVON Phone No. 995-2660, Commercial - (201) 544-2660.

7. Economics: (a) R&D expenditures leading to MOTS prototypes for NEMP or EMP protection were approximately $500,000. There has been no prior PEM funding, and no future PEM funding is anticipated. Implementation cost of $100,000 is anticipated in the form of a PIF effort in FY 81, in order to initiate production of the intended scale. (b) Using discount procedures mandated under AR 11-28, the calculated saving will-be $4,682,130 over and above the cost of this project. This is in addition to the benefits arising from the fact that in the absence of the MOTS device EMP protection of RF parts of tactical communications equipment is not possible without substantial insertion loss and/or increase in nonlinear receiver effects which would be caused by conventional devices. (c) The MOTS project will not have any adverse effects on the environment. The general safety of tactical communications equipment in the presence of high voltage threats including lightning and EMP will be improved.

Project No. F803024 (CORADCOM)

EXHIBIT P-16 (Part I)

DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: F803032 2. PA 5297 Cost: $400K

4. Title: MM&T - Connector Terminated Stripe Geometry Injection Lasers

5. Facility/Contractor: This project will accomplished at a privately owned manufacturing plant to be selected by competitive procurement. The responsible activity for supervision and control of this effort is CORADCOM.

6. Summary: (a) Purpose: The purpose of this project is the establishment of production capability for the growth of stripe geometry injection lasers and assembly of laser chips into connector terminated hermetically sealed packages. The devices will be used as sources in long-haul communications systems and in fiber guided missiles. (b) Problems: At the present time optical fiber transmission lines are coupled to the laser source by either of two methods. In method I the fiber is positioned in front of a window on the laser package. In method II the transmission line is coupled by means of a bulkhead connector which is in turn coupled to the laser via a fiber pigtail which exits the laser package. Both methods have been found to be unsatisfactory. Lasers for use by method I are difficult to manufacture. The laser chip must be soldered in position extremely close to a thin transparent window. Upon cooling, the solder may cause the chip to change position and thereby render the assembly useless, reducing yield. Further, assuming successful assembly of the component laser, the fiber transmission line must be positioned very accurately in front of and close to the window. This positioning must be done while the optical power out of the fiber is monitored, to assure maximum coupling. The eliminates the possibility of repair, except at depot level. Lasers for use in method II are somewhat easier to manufacture, primarily because laser chip positioning is not so critical. For method II, the laser chip is conventionally mounted on a heat sink and a cap, to which a fiber pigtail has been hermetically attached, is positioned over the laser and adjusted for maximum coupling to the pigtail. While an improvement over method I, this approach is also unsatisfactory since it has been shown that even careful handling leads to breakage of the pigtail. The entire subassembly must be replaced, again at the depot level. These facts imply that complete transmitter modules must be kept on hand at the operational level, increasing the cost of fiber optic systems. (c) Solution: Single stripe injection laser diodes with a short fiber pigtail will be assembled in a hermetically sealed package. This subassembly is then mated with a fiber optic connector to form an integral laser-connector package. All subsequent optical connections to the device are made with mating connectors. Devices which fail can be replaced easily at lower echelons, reducing the cost of spare parts inventory and reducing down time. (d) End Products: The end product of this funding will be the establishment of a volume production capability for fabricating connector terminated injection laser. A final Engineering report will be distributed to the industry. (e) Implementation: After completion of the project, the contractor will conduct a demonstration to industry of the process accomplishment and improvements.

7. Economics: The R&D covering injection lasers has been performed by ERADCOM and industry sources. The total R&D funding between 1973 and 1978 is approximately $500K. MM&T funding for FY-80 is $400K. There has been no past MM&T funding and no future MM&T funding for these devices is anticipated. The use of this technology will significantly impact the cost, ruggedness, efficiency, and repairability of systems using these devices. Based on requirements of 14,550 devices over the three year period after process establisyment, an estimated net savings, discounted in accordance with AR 11-28, of 3,583,000 will result. The performance of this project will not have an adverse impact on the environment.

Project No: F803032 (CORADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)

RECEIVED 5 MAY 1978

DATE: 1 May 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. F803040 (CORADCOM) 2. PA 5297 3. Cost: $1,500.0

4. Title: (MM&T) Owens-Illinois (O-I) Compatible AC Gas Discharge Display

5. Facility/Contractor: This project will be accomplished at a privately owned manufacturing facility selected through negotiated competitive bidding and will be supervised by CORADCOM.

6. Summary: (a) Problem - The Army has recently developed two systems which utilize 8½" x 8½" AC Gas Discharge Display panels produced by Owens-Illinois. These systems are the Tactical Computer System (TCS) which shall support the Tactical Operation System (TOS) and the Battery Computer System (BCS) supporting the TACFIRE user within the Army. Owens-Illinois has stopped the production of the required display panel and there are no American companies engaged in the commercial production of these panels. The fact of this stoppage would jeopardize the future production of the TCS and BCS. (b) Solution - The equipment, expertise and patent rights for low quantity production of AC Gas Discharge Display panels are still owned by Owens-Illinois. The proposed solution is to support a privately owned manufacturing facility which will negotiate with Owens-Illinois to obtain the patent rights, facilities and expertise necessary to produce these display panels in production quantities. The Owens-Illinois Company has concluded their research and development efforts several years ago and therefore no further R&D shall be required. (c) End Products - The end products of this effort will include a pilot production of AC Gas Discharge Display Panels and manufacturing data sufficient to allow other qualified manufacturers to produce these display panels. (d) Implementation - A prototype line demonstration will be accomplished at the conclusion of the project. This prototype line will than be used to meet the projected quantity requirements for this product. Technical point of contact: Erich F. Kral/Autovon - 995-4080.

7. Economics - There have been no prior PEM funding and no future PEM funding is anticipated. Implementation cost is not anticipated in as much as the cost for the effort contemplated is included as part of the project cost. The unavailability of the display panels would necessitate the redesign of the already existant equipment in the TCS & BCS. The execution of this project will not have a significant effect on the quality of the environment.

Project No. F803040 (CORADCOM)

DUPLICATE

EXHIBIT P-16 (Pa

DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: F803041(CORADCOM) 2. PA 5297 3. Cost: 900K

4. Title: (MM&T) Elimination of Hard Copy Documentation

5. Facility/Contractor: This project will be performed in-house by CAD-E/CAM Division, Technical Support Activity (official designation within CORADCOM not known at this time) and by competitively selected contractors.

6. Summary - (a) Problem - The production of ITDT documentation for training and maintenance information is expected to substantially increase the quantity of paper necessary for support of Army systems. For example, there will be on the order of 6000 pages of documentation on each turret alone of the Army's new main battle tank. The support and usage of such voluminous material poses a significant problem for field utilization. Applications of video disc and electronic display technologies are being pursued to deal with this situation. The problem occurs, however, in converting the ITDT information from the printed page format to one which is compatible with electronic display, whether digital or video. (b) Solution - Current R&D efforts have been initiated to deal with the conversion problem itself which will result in a methodology for format conversion. Electronic display technology will be utilized to minimize the problems of documentation manageability while increasing maintenance and maintenance training effectiveness. (c) End Product - This project will determine and produce software/hardware necessary to implement the process for the reformatting of paper format ITDT information to electronic display format as prescribed by the conversion methodology. (d) Implementation - The results of this project and a computer program will be disseminated to industry and other Government agencies.

7. Economics: No known efforts have been expended by the Government in this project area. No additional funding for this project is anticipated. Expected cost savings as a result of the use of electronic display technology have been shown (Draft ROC, dated 28 Feb 78 for an "Electronic Information Delivery System (EIDS)") with regard to initial production and reproduction costs. It is estimated that approximately 7200 pages of paper documentation could be stored on an electronic system for the same cost as it would take to produce a single sheet of paper and in a fraction of the storage area. The execution of this project will not have a significant impact on the quality of the environment.

Project No. F803041(CORADCOM)

CM

EXHIBIT P-16 (Part I) DATE: 1 May 1978

RECEIVED 5 MAY 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No: H803009 (ERADCOM) 2. PA 5297 Cost: 600K

4. Title: MM&T - 10 Micron Waveguide Lasers

5. Facility/Contractor: The project will be accomplished at a privately owned manufacturing plant to be selected by competitive procurement. The responsible activity for supervision and control of this effort is ERADCOM.

6. Summary: (a) Problem: Establish production techniques for manufacture of 10 micron waveguide lasers. These long wavelength lasers are FLIR compatible and have improved propagation characteristics in fog, haze and battlefield smoke environments. They are to be used as transmitters in beamrider antitank missile guidance systems, i.e., AHAMS. Beamrider guidance optics are being separately developed in an MMT program under the auspices of MIRADCOM. Lasers used in testing to date have been constructed in single unit quantities and are therefore quite expensive. They exhibit some variation in characteristics and lifetime. Furthermore, they have not been hardened to uniform standards required for beamrider missions. Additionally, expanded mission needs anticipated make it advantageous to require such lasers to operate in the pulsed as well as CW mode. (b) Solutions: Manufacturing techniques are to be developed to fabricate smooth, low loss waveguide bores or channels in alumina or other appropriate ceramics using batch production techniques. Grinding and drilling methods are to be developed for large lot finishing of end faces of laser heads fabrication of input holes and gas ballast volumes. Vacuum processing and sealing methods which are inexpensive are to be developed. Gas fill mixtures which optimize pulsed or CW laser operating efficiencies and operating lifetimes will be used. Compact inexpensive power supplies for efficient pulsed and CW electrical excitation of these lasers should be specified. Modular construction techniques allowing a variety of laser sizes will be emphasized. The overall cost of these lasers including mirrors and power supplies will be reduced by a factor of 10 allowing large scale production costs of between $700 and $1000 per unit. (c) End Products: The end product of this funding will be the establishment of a volume production capability for manufacturing modular, mission hardened, sealed-off 10 micron waveguide lasers of assured reliability and lifetime. A final Engineering Report will be distributed to the industry. A total of 8 modular lasers, 4 pulsed and 4 CW of 4.5 and 9 inch active lengths will be delivered to ERADCOM for evaluation and distribution to other commands. (d) Implementation: After completion of the project, the contractor pursuing the program will conduct a demonstration to industry of the process accomplishments and improvements. POC: Dr. A. Papayoanou, AV 996-5779.

7. Economics: (a) R&D related effort is being performed currently under ARO Contract DAAG29-76-C-0009 using ERADCOM funds. Overall ERADCOM R&D funding to date is approximately 600K with about 200K of this amount expended on in-house efforts. Total funding for this two year MM&T program beginning in FY-80 is 600K. There has been no past funding and no future MM&T funding is anticipated.. (b) This technology will significantly reduce the cost and improve the reliability of these lasers thereby advancing their usage with 8 to 12 micron FLIR systems. Present single unit waveguide lasers cost between 10 and 20K depending on size. In larger quantities this cost can be reduced to 5K even if hardening is required. This MM&T program will reduce the initial cost to 1K and eventually to 0.7K. (c) Based on requirements for 4700 laser transmitters required only for the AHAMS program over a 4 year period after process establishment, an estimated net savings, discounted in accordance with AR 11-28 of $4,962,160 will result. The execution of this project will not have an adverse effect on the environment.

Project No: H803009 (ERADCOM)

EXHIBIT P-16 (PART I) DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (RI)

1. Project No. H803010 (ERADCOM) 2. PA 5297 3. Cost: $ 900

4. Title: MM&T Millimeter-Wave Sources for 60, 94, and 140 GHz.

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility. Selection of a contractor will be accomplished through competitive bidding. The project will be supervised and controlled by ERADCOM, Fort Monmouth, NJ.

6. Summary: (a) Problem: New Army electronic systems capable of penetrating smoke, fumes, dust, and adverse weather, require high performance, low cost, millimeter-wave sources for transmitter and receiver applications. Improved resolution, increased operational range and accuracy, and all-weather capability are the major requirements. The transmitter and L.O. need for these systems can be filled by silicon double drift IMPATT sources; however, they are only available in small, low yield R&D quantities with prohibitively high unit costs and lacking in field-replacement geometries. The primary reasons for the high unit costs are the low device yields due to a lack of precision process control and the absence of a commercial thrust. (b) Solution: The goal of this project is to establish techniques and processes capable of producing silicon double drift IMPATT sources. Precise and rigorous computer control of all material and device processing and test procedures is mandated. At least an order of magnitude improvement over previous computer controlled processing is necessary to achieve reliable, low cost, field replaceable sources. Chemical vapor deposition (CVD) and molecular beam epitaxy (MBE), both under computer control, will be evaluated as techniques for achieving the degree of precision required for producing these sources. (c) End Products: End products are: Manufacturing and process control plans, data, and analyses; quality control procedures and inspection aids; production test techniques; computer optimization techniques, analyses, and programs; test data and life test data; quarterly technical reports; procedures, techniques, and processes resulting in IMPATT sources production; sample IMPATT sources from the above. (d) Implementation: At the end of this project, manufacturing methods, techniques, and processes will be available for producing silicon double drift IMPATT sources for large scale usage in high resolution radar, secure communication, missile and shell guidance, and electronic warfare systems. No additional action will be required to implement the results. (e) The point of contact is: Albert J. Kerecman, Autovon 995-2152.

7. Economics: (a) The R&D relating to this procurement has been sponsored by several government agencies, and a total expenditure of over $2,000,000 is estimated. The funding for the proposed MM&T project is $900,000. No prior year MM&T funds were expended and none are programmed for the future. The per unit cost of each millimeter-wave silicon double drift IMPATT sources will be reduced from a present low volume cost of $5000 to $500 with a net present value savings of almost $150,000,000. The execution of this project will not have a significant impact on the quality of the environment.

Project No. H803010(ERADCOM)

DUPLICATE

RECEIVED 5 MAY 1978

EXHIBIT P-16 (Part I) DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (RI)

1. Project No: H803012 (ERADCOM) 2. PEMA 1497 3. Cost: $285,000

4. Title: MM&T - IR Source for AN/ALQ-144

5. Facility/Contractor: A privately owned facility selected through negotiated competitive bidding.

6. Summary: (a) Problem: The device has a unique design incorporating a boron nitride radiating surface heated by a graphite or tungsten heating element inclosed in a hermetically sealed sapphire envelope. Construction of the device utilizes handcrafted parts. Thin wall cylinders of boron nitride and/or graphite with 5 mm diameter and 117 mm length must be machined from solid stock. Uniform thickness and composition must be maintained. The sapphire-kovar seal must withstand severe temperature cycling placing restraints on dimensional tolerances of the seal. The sapphire is a high cost item and therefore must have a low rejection rate. The assembly of parts must meet stringent mechanical and electrical criteria. A device burn-in will be required to stabilize operating parameters. There is no immediate non-military application of this device. (b) Solution: Specialized fixtures and tools will be designed to support and machine thin wall cylinders to reduce setup and handling. A production method to grind and test the sapphire envelope for roundness will be established. Methods of mounting and aligning the radiator in the envelope without contamination will be established. An easy access, multiple-device burn-in test station will be designed and built. (c) End Products: A specific output of this project will be quarterly and final engineering reports and manufacturing data which will be distributed to industry. Manufacturing and quality control processes will be established and proven by being used on a prototype line to meet a specified production rate. (d) Implementation: Full disclosure of the device and its fabrication will be made. The pilot line will insure meeting initial requirements. Subsequent production buys will be on a competitive basis. Engineer: J. C. O'Connell, Autovon 996-5362.

7. Economics: (a) $160,000 was expended in FY-77 in a dual competitive award to establish the feasibility of the selective emissivity source concept (Project #1L7 62705 AH94 E1-07). A follow on contract for $125,000 will be awarded in Apr 78 to continue development (Project #1L1 62705 AH94 E1-07). It is anticipated another $400,000 will be required for system qualification. The projected PEM funding for FY-80 is $285,000. Additional funding would be required to procure the sources in production quantities. (b) As a result of this MM&T it is expected that a cost savings of $120 per source on the present cost of $500 will be realized. The economic analysis is based on estimates for maintenance and training requirements. It is estimated a savings, discounted in accordance with AR 11-28 of $1,105,000 will result. (c) This project will not result in any significant adverse impact on the quality of the environment.

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (RI)

1. Project No.: H803018(ERADCOM) 2. 3. Cost $620K

4. Title: MM&T - Production Techniques for 1 Megawatt HELS Switch

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through negotiated competitive bidding.

6. Summary: a. Problem - One of the major problems in the development of such a weapon system is to reduce the size and weight of the system package for mobile application. A one megawatt average power thyratron that replaces six of the highest power thyratrons currently available has been developed. The prototype thyratron switches satisfy the electrical requirements, however the tubes are presently handmade using expensive highly skilled model shop technicians. Production techniques for conventional thyratrons cannot be used to produce the MAPS 40 thyratrons. The tube parts are not designed for production. The cathode area is 5000 cm^2 in comparison to 800 cm^2 of the cathodes of the largest thyratrons now being produced. The completed tubes require high voltage aging. No manufacturer has the required high power facility. The maximum production rate using available production techniques is two tubes a month which is much too low to support future weapon system development. b. Solution - This MM&T program will develop production techniques for building high power thyratrons such as the MAPS 40. The following tasks will be accomplished: (1) develop automatic tooling and cutting of molybdenum parts; (2) design parts for production; (3) design tube parts so that defective subassemblies can be salvaged by reworking and failed tubes can be reprocessed by replacing faulty parts; (4) obtain Bell furnace for brazing 8-9" diameter parts (furnace 18" diameter - 24" high); and (5) obtain 1 megawatt test facility to age and season tubes. c. End Products. This project will provide production techniques to fabricate high power thyratrons. A low volume capability will also be provided to support future directed beam weapon systems. d. Implementation - Pilot line will provide initial requirements. Final reports will be distributed to thyratron manufacturers. Production orders in quantity will encourage competitive bidding resulting in further savings. Engineer: John E. Creedon, Autovon 996-5437.

7. Economics: a. $250,000 was expended in FY-76 and FY-77 under Contract No. DAAB07-76-C-1352, Project/Task No. 1L762705AH94E105 to accomplish the required R&D to achieve the required electrical performance. The projected PEM funding is $620,000. b. As a result of this MM&T, it is expected that a cost saving of $6,000 per switch will be realized. Based on requirement of air defense systems plus a 10% maintenance float, an estimated net savings, discounted in accordance with AR 11-28 of $3,441,100 will result. c. This project will not result in any significant adverse impact on the quality of the environment.

Project No. H803018(ERADCOM)

RECEIVED 6 JUL 1978

EXHIBIT P-16

DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSRD-165 (RI)

1. Project No.: H803019(ERADCOM) 2. 3. Cost: $360,000

4. Title: MM&T - High Energy Density Pulse Capacitor

5. Facility/Contractor: A privately owned manufacturing facility selected through negotiated competitive bidding.

6. Summary: (a) Problem - Among the critical requirements related to fielding a directed beam weapon system is the need to reduce the size and weight of a multi-megawatt average power subsystem by at least an order of magnitude. The pulse capacitors used in the pulse forming networks of the modulator are responsible for a major part of the size and weight. An R&D program improved the energy density of the capacitor from 10 joules per kilogram to greater than 70 joules per kilogram. The prototype high energy density capacitors are made using model shop techniques. The production rate is too low to produce the projected number of high energy systems. A production of 400 capacitors per month will be required during FY-84, 85, 86, 87. A handmade plastic case is used. The basic dielectric is polycarbonate or polypropylene. The capacitor winding technique contributes to wrinkles in the foil or dielectric sheet. The capacitor foil edges are hand sealed with a large soldering iron. The quality of work varies from day to day. The liquid impregnant is castor oil, which is the best environmental compatible impregnant available. Improved techniques to filter the castor oil will improve reliability. Facilities for testing a complete capacitor at full power are not available. (b) Solution - The following tasks will be accomplished on the MM&T program: (1) A mold will be developed that will permit the molding of the capacitor case. (2) A detail study of the two dielectric materials polycarbonate and polypropylene will be conducted and the best material selected. (3) A constant tension capacitor winding machine will be constructed. This will reduce capacitor failures due to material wrinkles. (4) An automatic edge foil sealing technique will be developed. (5) A one kilojoule 40 kilovolt test facility that will permit testing of a complete capacitor will be obtained. (c) End Products - This project will provide production techniques to fabricate high energy density pulse capacitors for future high energy laser weapon systems. A low volume production capability will be provided to support future directed beam weapon systems. (d) Implementation - Pilot line will provide initial requirements. Final reports that will include detailed production drawings, processing, and quality control information will be distributed to capacitor manufacturers. Production orders in quanity will encourage competitive bidding resulting in further savings. Engineer: John Creedon, Autovon 996-5437.

7. Economics: (a) $250,000 was expended in FY-76 and FY-77 under project DAAH01-75-C-1090 to accomplish the required electrical performance. The projected PEM funding is $360,000. Additional funding would be required to procure the capacitors for system production requirements. (b) As a result of this MM&T, it is expected that a cost saving of $212 per capacitor will be realized. Based on requirements of air defense systems plus a 20% maintenance float, an estimated net savings, discounted in accordance with AR 11-28 of $2,236,600 will result.

EXHIBIT P-16 (PART 1) DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. H803020 (ERADCOM) 2. PEMA 5297 3. Cost: $250K

4. Title: Fast Risetime SCR Switch MMT

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through negotiated competitive bidding.

6. Summary: (a) The Problem. Several microwave and laser systems presently in operation or planned in the near future make use of a silicon controlled rectifier (SCR) to generate the primary pulse. Three such systems include the PPS-5, which is a microwave system, and the PAQ-1 and PAQ-3, which are laser systems. The PPS-5 uses a 2N4203 (made by Motorola) and both the PAQ-1 and PAQ-3 use a 2N4204 (also made by Motorola). The SCR units are costly. The cost of the 2N4203 is $114.00 while that of the 2N4204 is $134.00. The problem is the high production cost related to the individualized fabrication techniques which each SCR requires. Low yields combined with the necessity to perform testing and other processing only after the SCR units are mounted contribute to the large cost. (b) The Solution. The two SCR units are similar. The voltage capability is 700 volts for the 2N4203, and 800 volts for the 2N4204. Other characteristics are the same: the peak current capability is 100 amps, the average current capability is 2 amps, and the risetime is in the 100 nanosecond range. The MMT will provide production engineering which will result in low cost efficient fabrication techniques, enabling production of a single SCR which will simultaneously satisfy the requirements of all three systems. The fabrication processes which will be made more efficient include: (1) silicon preparation, (2) junction formation, (3) contacting, (4) passivation, and (5) testing. To facilitate fabrication, testing and other processing will be done while in wafer form, prior to mounting and assembly. (c) The End Product. A specific output of this project will be quarterly and final engineering reports and manufacturing data to allow any competent manufacturer capability to duplicate the results. A quantity of SCR elements will be produced to enable demonstration and evaluation of the process. (d). Implementation. A pilot line will supply initial requirements. Full disclosure of device and fabrication will be supplied to industry. High volume and competitive production awards will result in additional sources. Engineer: Maurice Weiner AUTOVON (99)-65362.

7. Economics: (a) The projected PEM funding for FY-80 is $250,000. Additional funding would be required to procure the SCR elements for system production requirements. (b) As a result of this MM&T based on an anticipated total requirement of 12,920 SCR units during FY-81 to FY-91, an estimated net savings of $382,800 will result, discounted in accordance with AR 11-28. (c) This project will not result in any significant adverse impact on the quality of the environment.

Project No. H803020(ERADCOM)

Done

CM
HW

EXHIBIT P-16 (PART I)

RECEIVED 6 JUL 1978

DATE: 27 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD-1125(R1)

1. Project No: H803023 (ERADCOM) 2. PA-5297 3. $800
4. Title: MM&T - Manufacturing Methods for Military Plasma Panel Displays

5. Facility/Contractor: This project will be performed at a privately-owned manufacturing facility selected through competitive bidding. The responsible activity for supervising the effort is ERADCOM.

6. Summary:

a. Problem: Army systems such as the Battery Computer System (BCS) supporting the TACFIRE, the Tactical Computer System (TCS) supporting the Tactical Operation System (TOS), and electronic warfare systems such as QUICKFIX AND MULTEWS utilize plasma panel displays for their command and control information. These systems are well into their hardware stages. There is no existing U. S. manufacturing service, nor is there a proven manufacturing technology for such panels. A redesign of the Army systems for a different display type such as a cathode-ray tube, would be prohibitively expensive and time consuming.

b. Solution: Efficient manufacturing methods and techniques will be developed to produce reliable plasma panel displays. These will include automatic methods for spacer insertion and electrode and dielectric deposition as well as the incorporation of in-line processing techniques.

c. End Products: This project will provide manufacturing and process control technology needed to replace expensive manual methods with cost saving automatic technology.

d. Implementation: At the conclusion of this program no further implementation will be required other than to procure the necessary quantities needed for Army systems.

e. Point of Contact: Mr. Isidore H. Stein, Autovon 996-5547.

7. Economics:

a. I. R&D Expenditures

	FY77	FY78
Authorized	0	0
Obligated	0	0
Expenditures	0	0

II. MM&T Expenditures (Projected)
FY80 - $800K

III. Additional Expenditures: Further funding would be required to procure the plasma panels needed for system production requirements.

b. The Economic Analysis, Inclosure 2, indicates a net cost saving of $5,735,646.

DUPLICATE

RECEIVED 5 MAY 1978

EXHIBIT P-16 (Part I) DATE: 25 April 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (RI)

1. Project No. H803025 (ERADCOM) 2 PA 5297 Cost $500

4. Title: MM&T For a Low Cost Intraconnection System For Microwave Power Transistors

5. Facility/Contractor: This project will be accomplished at a privately owned manufacturing plant to be selected by competitive procurement.

6. Summary: (a) Problem: Current experience in the development of large scale L and S-band solid state phased array radars and microwave communications transmitters has indicated that if these systems are to become economically feasible much lower cost microwave bipolar transistors will have to be forthcoming. Present microwave power transistors utilize a large number of bonded wire leads to interconnect the multiple base, emitter, impedance matching elements of multi-cell transistor die. Most high power state-of-the-art microwave transistors also utilize these bonded wires for the realization of precise inductor values which interconnect with capacitors to realize transistor matching circuits within the package. The number of lead bonds often approaches one hundred in current multi-cell geometry transistors. The lead bonding is a tedious, time consuming manual task for skilled production personnel contributing much cost to the transistor. Inherent in such assembly are undesirable variations in lead lengths from the appropriate length. This causes electrical differences which compromise transistor performance and also contribute to spreads in transistor to transistor performance characteristics. (b) Solution: Establish and optimize a gang bondable tape intraconnection system for use in the manufacture of multicell microwave power transistors. This system will provide precise control of interconnection lengths as well as assuring reliable bonding achieved in a rapid, automatic, low cost fashion. The automated system proposed for this MM&T would increase the producibility of a microwave power transistor by reducing the time to bond interconnects to less than one minute; relax the degree of skill required by the associated workers; and result in an improved product uniformity independent of the assembly workers judgement. (c) End Products: A manufacturing data package, soft tooling, a quantity of metalized and patterned tapes, and sample transistors. (d) Implementation: The availability of a low cost production method for assembling microwave power transistors will lead to its use at one or more transistor manufacturing plants. (e) Point of Contact: Russell Gilson 995-4917

7. Economics: The R&D for this project was accomplished under contracts DAAB07-75-C-1335 and DAAB07-77-C-2689 at a total cost of $195,000. No prior year MM&T funds were expended on the project and none are programmed for the future. It is estimated that this project for low cost microwave transistors will cost $500,000. After completion of this project, it is estimated that the present cost of internally matched multicell microwave power transistors will be reduced from a present cost of $75 each to a cost of $25 each. A new present value savings of approximately $1,432,000 is anticipated.

Project No. H803025(ERADCOM)

EXHIBIT P-16 (Part I) DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No: H803026 (ERADCOM) 2. PA 5297 3. Cost: $1,100.00

4. Title: MM&T for High Pressure Oxide IC Process

5. Facility/Contractor: This project will be accomplished at one or more privately owned plants selected through competitive bidding. It will be supervised by USAERADCOM, Fort Monmouth, NJ.

6. Summary: (a) Problem: VLSI* subsystems will be introduced in Army equipment in significant numbers during the next decade as requirements grow for increased performance in secure communications systems, high speed EW/SIGINT signal processing systems, expendable smart jammers, high speed data links, and associated equipments. The use of present technology to effect VLSI subsystems will introduce new reliability problems, fabrication yield difficulties, and eventually an increase in VLSI cost. Process temperature reduction is a high pay-off area since temperature is a factor to which reliability and yield are particularly sensitive. Silicon oxidation is one microcircuit process which can be improved by temperature reduction. The bulk of all silicon oxidation processes are performed at temperatures greater than 1000°C using conventional techniques. Without technology advances, yield and reliability of complex VLSI will suffer, and costs will limit VLSI use in military systems. (b) Solution: It has been demonstrated that when silicon is oxidized at pressures above one atm. reductions of as much as several hundred degrees in temperature can be realized, and oxide improvement is indicated. Laboratory equipment for silicon pressure oxidation has been built and demonstrated. Recently domestic and Japanese commercial equipment has appeared for the lowest end of the pressure regime. Pressure oxidation (P-OX) will result in economic advantages since IC throughput, yield, and performance will be increased. (c) End Product: The end product will be a proven high yield manufacturing process for reliable high performance VLSI subsystems. (d) Implementation: Complete documentation will be provided for the process and for any special pressure oxidation equipment developed under this program. (*Very Large Scale Integrated Circuits). POC is S. Marshall, AV 995-4040, DELET-IS.

7. Economics: Applicable R&D covering silicon P-OX was performed by ERADCOM. During the period FY-74 - FY-77 the R&D was funded under the following internal ILIR 6.1, and 6.2 projects: 1T1 61102B 11A, 1T1 61102A H47, 1S1 61102A H47, 1L1 61102A H47, 1T1 61101A 91A, 1S7 62705A H94, 1L7 62705A H94. The dollar value of internal R&D for the period cited was $853K, No prior year MM&T funds were expended and none are programmed in the future. This project will cost $1,100,00. As a result of the project VLSI costs will be reduced and the Army's projected average microcircuit cost will be decreased from $30 to $20 per unit. Based on requirements for 24 million devices over a five year period after project completion, an estimated net savings, discounted in accordance with RA 11-28, of $37,686,200 will result. The execution of this project will not adversely affect the environment.

PROJECT NO: H803026 (ERADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: H803028 (ERADCOM) 2. PA 5297 3. Cost: $500K

4. Title: MM&T - High Power X-Ray System for IC Lithography

5. Facility/Contractor: This project will be accomplished at a privately owned plant selected through competitive bidding. It will be supervised by USAERADCOM.

6. Summary: (a) Problem: The pressing need for high speed signal processing and Electronic Warfare systems can only be met by devices having substantially lower LSI geometries (1 μm or less) that can only be fabricated by new fine-line lithography. Present replication of mask patterns by the use of light has reached resolution limits for mass production of non-microwave, multiple level registration IC's at approximately 2 μm line widths, due to optical diffraction effects. To circumvent this problem, soft x-rays of discrete wave lengths of 4A°, 3.3A°, 13.3A° etc. are being used for the exposure media. However, no x-ray machines for continued operation in a rugged production environment are available to electronic industry. Small lab built x-ray systems exist for exploring the feasibility of x-ray technology, but are not reliable and operable by low echelon production personnel. (b) Solution: An x-ray system prototype must be manufactured with the following specifications: (1) 15 - 20 kw x-ray source, (2) A 3" wafer exposure capability, (3) distortion and alignment errors within 0.25 to 0.5 μm total, (4) a 0.5 μm line resolution capability, and (5) exposure time limit of 60 s or less. (c) End Product: A low cost basic x-ray system at a cost not to exceed $75,000 that can meet the above specifications with add on flexibility for interfacing with computer controls, and laser alignment capability. (d) Implementation: The contractor will be required to maintain a manufacturing capability for this machine to meet orders from military semiconductor manufacturers, for a period of 2 years for x-ray machines to be used in medium volume production line of high performance, high yield, high density integrated circuits. (e) Industry Demonstration: After completion of the project, the contractor will conduct a demonstration to industry of the x-ray systems capabilities. POC is A. Mark, Autovon 995-4396. DELET-ID.

7. Economics: The use of x-ray lithography for fabricating military integrated circuits using lab type machines has been established under R&D contract DAAB07-77-C-2669 and related industry IR&D efforts. No Government sponsored efforts to productize a low cost x-ray system have been funded so far. As a result of this project, an x-ray system in the power range required will be made available at a price of approximately $75,000. Reduction in cost structure will accrue because of reduced cost of capital equipment, the competition generated by the availability of the x-ray machine, and also because of yield improvements and process simplification. Based upon requirements for 333,000 devices over a three year period after project completion, an estimated net savings discounted in accordance with AR11-28 of $3,564,200 will result.

PROJECT NUMBER: H803028 (ERADCOM)

EXHIBIT P-16 (Part I) DATE: 1 July 1979

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: H803031 (ERADCOM) 2. PA: 5297 Cost: $550K

4. Title: MM&T - 10.6 um CO_2 TEA lasers

5. Facility/Contractor: This project will be accomplished at a privately owned manufacturing plant to be selected by competitive procurement. The responsible activity for supervision and control of this effort is ERADCOM.

6. Summary: (a) Problem: Establish production methods to manufacture 10.6 micron CO_2 TEA lasers in required quantities at reasonable costs. Present methods produce such lasers in single unit quantities without utilizing volume production techniques. Costs are therefore high and the lasers have not been constructed under standardized specifications. These lasers are required to be incorporated with FLIR imaging devices in order to provide target ranging capability for weapons delivery systems. Present laser rangefinder technology, at 1.06 microns, has reduced all weather capabilities and is severely restricted by available countermeasure smokes. The longer wavelengths available with CO_2 TEA lasers give greatly improved propagation characteristics while having wavelength compatibility with the 8 to 12 micron FLIR's. (b) Solutions: Develop manufacturing techniques for volume production of modular CO_2 TEA lasers to be incorporated into tank thermal imagers, TTS, TIS, RPV, etc. Units will be hardened to withstand the shock and vibration of a tank environment without degradation of laser characteristics. Techniques suitable for large scale production of vacuum tight seals and chemically cleaned interior components as well as rapid and accurate alignment of electrodes and end mirrors will be devised. Large scale production of laser components including mirrors, electrodes and laser envelopes will be established. Materials chosen for the envelope and mirrors will assure a minimum 10 yr shelf life. Operating life tests and accelerated shelf life tests will prove that desired lifetimes have been attained. Electrical pulsers, PFN's (i.e. power conditioners) appropriate for these lasers will be developed in a separate ERADCOM MM&T program. However, this MM&T program will establish exact specifications required for electrical pulsers to optimize laser performance. Further, the modular design of the lasers will allow appropriate space and leads for pulsers. (c) End Products: The new manufacturing processes will be applied to produce 6 prototype units for test and evaluation. The prototype units will include electrical pulsers, which though not optimized, are suitable for testing laser operation. A final Engineering Report describing the new processes will be prepared for distribution. (d) Implementation: Upon completion of the program, the contractor pursuing the program will conduct a demonstration to industry of the process accomplishments and improvements. POC: Dr. G. R. Osche, AV 996-5779.

7. Economics: (a) Overall R&D funding to date, contractual and internal, is approximately $650K. MM&T funding for this two year effort beginning in FY-80 is $550K. There has been no past funding and no future MM&T funding is anticipated. (b) Benefits to the government will include the establishment of techniques to produce mission hardened, reliable CO_2 TEA lasers at low cost. Such lasers will extend the performance capability of thermal imaging systems. Based on requirements for 22,334 devices for integration with FLIR systems an estimated net savings discounted in accordance with AR 11-28 of $38.108,121 will result. (c) The performance of this project will not have an adverse effect on the environment.

EXHIBIT P-16 (Part I) DATE: 1 July 78

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD 161 (R1)

1. Project No: H-803501 (ERADCOM) 2. (PA 5297) 3. Cost: $750K
4. Title: Third Generation Photocathode on Fiber Optic Faceplate.
5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive bidding. The responsible activity for supervising the effort is NV&EOL.
6. Summary: a. Problem: Second generation image intensifier tubes perform satisfactorily under quarter moonlight conditions, but for many applications, they are limited in performance under starlight condition by the relatively poor response of the S-20 photocathode surface. Present third generation (.9 micron) photocathodes are sealed to glass input faceplate. These photocathodes have demonstrated sensitivity improvements of four times the S-20 at quarter moon allowing satisfactory performance under starlight conditions. However, image tubes incorporating these high performance photocathodes are limited to specific system application, due to glass parameters. The optical properties, perse, of this glass faceplate are sufficient however, the short focal length of the objective lens of existing systems restrict proper focusing of the image plane on the photocathode surface. B. Solution: In order to circumvent having to design new third generation systems to replace the existing systems, it appears feasible to conduct this program to manufacture the highly sensitive .9 micron photocathode on Fiber Optics. This would allow the high performance tubes, as well as the future low cost third generation tubes to be a direct retrofit for the existing fielded second generation systems. The end life for 3rd generation image intensifier tube assemblies, with the same decay characteristics, will exceed that of long life 2nd generation due to the initial higher photocathode sensitivities. c. End Product: This project will provide the manufacturing methods and technology for producing the third generation (.9 micron) photocathode on fiber optics, sample photocathodes, and a pilot production line with implemented automation and quality control procedures. d. Implementation: The Third Generation photocathode on Fiber Optics will replace the present S-20 cathode surface of the image intensifier tube allowing for use in a broad range of system applications. At the conclusion of this program, no further implementation of other MM&T programs will be required, other than Engineering Change Proposal (ECP), to incorporate the cathodes into image intensifier tubes. e. Point of Contact: Kurt Villhauer, (AV) 354-1725.
7. Economics: a. R&D efforts funding FY-76 through FY-79 is planned at 318K. MM&T funding for FY-80 is 750K. There will be no additional Government cost to implement the results of the project. b. The use of this technology will significantly increase the tube life and performance and have an impact on reduction in the overall cost of the manportable and Combat Vehicle Night Vision System due to retrofit application. Based upon the tube requirements for these systems over the four year period after process is established, an estimate savings discounted, in accordance with AR11-28, $32,371K will result. c. The performance of this project will have no adverse affect on the environment or violate safety standards.

PROJECT NO.: H803501(ERADCOM)

EXHIBIT P-16 (Part I) DATE: 1 July 78

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD 165 (R1)

1. Project No.: H803502 (ERADCOM) 2. (PA 5297) 3. Cost: $280

4. Title: MM&T - Improved Fiber Optic Inverter for 3rd Generation Image Intensifiers

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive bidding. The responsible activity for supervising the effort is NV&EOL.

6. Summary: a) Problem: Fiber Optic inverters used in 2nd Generation Image Intensifiers are not of sufficient quality for utilization in the 3rd Generation High Performance Aviation Goggles. The present geometry of the fiber optic inverters leads to excessive cosmetic problems and likewise a very low production yield. b) Solution: Inverters will be fabricated with a center to center spacing of 6 to 8 microns. Advanced methods will be utilized to improve geometry and subsequently yield. Resulting in lower cost, less chance of schedule slippage and possible application to 2nd Generation Programs. c) End Products: The end products for this project will be manufacturing methods for producing high quality fiber optic inverters, sample inverters, and a pilot line to verify the same. A final Engineering Report will be distributed to industry. d) Implementation: Advanced methods for fabricating fiber optic inverters will make the inverter viable for the 3rd Generation High Performance Goggle. Any resulting change from this project will be implemented via Engineering Change Proposal (ECP) into the 2nd Generation Intensifier Tube programs. No additional action will be required after successful completion of the PEM project program to obtain a return on investment. e) Point of contact will be E. Efkeman, DELNV-SE, (703) 664-1624, Autovon 354-1624.

7. Economics: a) R&D effort funding is being accomplished through Contractor IR&D. MM&T funding for FY80 is $300K. There will be no additional Government cost to implement the project results.

b) The use of this technology will significantly reduce the cost of the high performance twist which are used in the High Performance Aviation Goggles. Based upon requirements of approximately 5100 goggles (11,000 tubes) over the four year period after process establishment, an estimated net savings discounted in accordance with AR11-28 of $1,800,000 will result.

c) The performance of this project will have no adverse affect on the environment or violate safety standards.

PROJECT NUMBER: H803502 (ERADCOM)

EXHIBIT P-16 (Part I)

DATE: 1 July 78

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT

RECEIVED 6 JUL 1978

1. Project No.: H803503 (ERADCOM) 2. (PA 5297) 3. Cost: $700

4. Title: MM&T - Holographic Optics for Night Vision Goggles

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive bidding. The responsible activity for supervising the effort is NV&EOL.

6. Summary: a. Problem: Holographic diffraction optical elements are required items for an advanced Night Vision Aid System (see Inclosure 3 - HOT Goggle Feasibility Model). The requisite technology is currently limited to laboratory methods and techniques which are inefficient and costly. Because of their diffractive nature, holographic optics are extremely sensitive to wavelength characteristics which are effected by each step in the construction process. Thickness of the gelatin recording material will change with environmental variations and the hydrophobic nature of plastic substrates can cause this film to separate in its final configuration. Spurious reflections, air turbulence, acoustical noise and dust particles are sources for generating defective diffraction patterns during the exposure process. b. Solution: Establish manufacturing methods to produce inexpensive holographic diffraction optical elements by incorporating the necessary production controls to include: (1) repeatable and reliable gelatin coating techniques, (2) improved processing methods, (3) closer tolerances for each process step, (4) improved test methods and (5) better alignment techniques. In addition, the complete exposure construction optics and apparatus will be isolated and stabilized in a controlled clean room environment. Adhesion of dichromated gelatin to the plastic substrate will be improved by an intermediate subbing layer and moisture resistance will be obtained by sealing this same gelatin between plastic plates. In order to realize the cost benefits with this technology, the above production controls are necessary for yield improvements. c. End Products: The end products for this project will be manufacturing methods for producing inexpensive holographic optical elements, sample units, and a pilot line to verify the same. A Final Engineering Report will be distributed to industry. d. Implementation: Holographic diffraction optics will be used directly in the Low Cost Night Vision Aid System. No additional action will be required after successful completion of the PEMA project program to obtain a return on investment.

7. Economics: a. R&D effort funding FY75 through FY79 is planned at $906,000. MM&T funding for FY80 is $700,000. There will be no additional Government costs to implement the project results.

b. The use of this technology will significantly improve the visual capability of Night Vision Aids. Based upon requirements of approximately 36,720 holographic optical elements over the three year period after process establishment, an estimated net savings discounted in accordance with AR11-28 of $5,876,285 will result.

c. The performance of this project will have no adverse affect on the environment or violate safety standards.

PROJECT NO. H803503 (ERADCOM)

EXHIBIT P-16 (Part I)   DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD - 165 (RI)

1. Project No.: H803504 (ERADCOM)   2. (PA 5297)   3. Cost: $245K

4. Title: MM&T Advanced Methods for Fabricating Chalcogenide Glass Infrared Lens Blanks

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility which will be selected through negotiated competitive bidding. The manufacturer must demonstrate willingness to sell lenses and give complete technology, methods and techniques to other contractors selected by the Government. The responsible activity for supervising the effort is NV&EOL.

6. Summary: a. Problem: GeAsSe glass is compounded from high purity raw materials and cast into various shapes, i.e., cylinders or plates. These are then core drilled or sawed into appropriate glass blank sizes. The procedures for purifying, weighing, and compounding the glass are laboratory oriented and do not lend themselves to production rates. Glass index of refraction, transmission, and uniformity are dependent on these processes being controlled. Casting into solid shapes requires very precise methods of cooling to insure constituent materials do not crystallize and do not form striae (density variations) in the glass which will degrade optical performance and mechanical properties. Cost of raw materials, especially germanium, continues to rise; hence, concentration on yield improvement is required. b. Solution: Reusable quartz reaction and compounding tubes will be designed to replace current types which must be discarded. Techniques for removing particulate carbon from the reactants during compounding will be refined to yield cleaner glass. Optimum casting shapes will be developed to allow for much more accurate temperature control during the casting/cooling process to assure strain- and striae-free glass. Production methods to evaluate material uniformity and optical processes will be developed to reduce test time and improve glass quality. Techniques for cleaning and recompounding scrap from the drilling/sawing operation will be developed to increase material yield. c. End Products. The end products for this project will be manufacturing methods for producing substitute glass for IR lenses and a pilot line to verify the same. A Final Engineering Report will be distributed to industry. d. Implementation: Advanced methods for fabricating GeAsSe lens blanks will replace the present proprietary and potentially unattainable IR glass and processing techniques. No additional action will be required upon completion of the PEM project. e. Point of Contact: James R. Piedmont, DELNV-SE, (703) 664-1424

7. Economics:

a. There has been no R&D funding for this project. MM&T funding is planned in FY80 for $245K. There will be no additional Government costs to implement the project results.

b. This added technology will significantly reduce the cost and assure an available source of IR optical material used in thermal imaging devices supporting manportable and combat vehicle night vision systems. Based upon present requirements of approximately 20,000 IR lenses over a two year period after process establishment, an estimated net savings, discounted in accordance with AR-11-28, of $1,529,616 will result.

c. The performance of this project will have no adverse affect on the enviornmental or violate safety standards.

PROJECT: H803504 (ERADCOM)

EXHIBIT P-16 (PART II)

DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD-1125(R1)

1. Project No: H803505(ERADCOM) 2. PA-5297 3. $450

4. Title: MM&T - Automated Transparent Phosphor Deposition, Processing, Sealing and Test Techniques for High Contrast CRTs

5. Facility/Contractor: This project will be performed at a privately-owned manufacturing facility selected through competitive bidding. The responsible activity for supervising the effort is ERADCOM.

6. Summary:

a. Problem: The CRT displays used in Aircraft Survivability Equipment (ASE) and the integrated avionics control system (IACS), as well as other ground-based and avionics systems, are unsatisfactory due to poor sunlight legibility, and the need for environmentally unsatisfactory optical filters. A sunlight legible, 2-color CRT has been developed to solve these problems. This CRT requires high temperature faceplates to realize the optimum phosphor efficiency of the transparent phosphors. The phosphor-black layer deposition techniques and sealing of the alumina-silicate faceplate to the tube envelope via a graded glass and frit seal requires substantial labor, processing, assembly, and final acceptability tests. The labor cost of such extensive CRT fabrication is too high for a production facility.

b. Solution: The high labor costs will be greatly reduced by automating the deposition and processing of the phosphored faceplate, by automating the control of the frit sealing process and by automating the processing and final testing of the finished CRTs.

c. End Products: This project will provide manufacturing and process control technology and cost saving automatic technology needed to replace expensive manual methods of labor. A quantity of high contrast CRTs will be produced to enable demonstration and evaluation of the cost saving methods and manufacturing technology.

d. Implementation: At the conclusion of this program no further implementation will be required other than dissemination of the processing information throughout industry and the production of the necessary quantities needed for the AN/APR-39 and IACS.

e. Point of Contact: Mr. Philip F. Krzyzkowski, DELET-BD, Autovon 996-5205.

7. Economics:

a. I. R&D Expenditures: FY77-70K, FY78-80K,FY79-90K
Task: 1L762705AH94D1-08; 1L162705AH94D1-08

II. MM&T Expenditures (Projected)
FY80 - $450K

III. Additional Expenditures: Further funding would be required to procure the high contrast CRTs needed for system production requirements.

b. The Economic Analysis, Inclosure 2, indicates a net cost saving of $2,857,969.

PROJECT NO: H803505(ERADCOM)

EXHIBIT P-16 (PART I)
8151

DUPLICATE

RECEIVED 12 MAY 1978

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No. H803507 2. PA 5297 3. Cost: $240K
4. Title: MMT, Low Cost Molded Packaging for Hybrid Electronics
5. Facility/Contractor: Harry Diamond Laboratories/Contractor to be selected
6. Summary:

a. Problem. Thick film hybrid circuitry is extensively utilized for artillery, mortar, and rocket fuzes, and is planned for use in small caliber (30mm to 40mm) rounds. All of these fuzes are high-quantity, low-cost devices that must survive an extremely high "g" environment. To achieve high "g" survivability, these hybrids are presently foam or epoxy potted, in place. These methods, however, do not provide adequate environmental protection; conventional hybrid packages, such as hermetic packages, are not used due to cost considerations.

b. Solution. Develop a process for high-volume, low cost, sealing and protection for hybrid thick film circuits and other fuze electronics. The process to be pursued is based upon bulk film protection of the substrate, followed by molding of the electronics, and, in specific cases, metal plating of the molded module to provide electrical shielding. This method will provide better environmental protection for the electronics, and, as by-products, a lower cost encapsulation due to shorter cure times, and less environmental problems due to the outgassing of foams during the curing cycle.

c. End Product. A process, and associated equipment for low-cost packaging of electronic circuits. The end product of this PEM project will be a technique for encapsulating the M734 amplifier by molding, and equipment for doing so on a continuous production basis. The process and equipment will be easily adaptable to other electronic designs.

d. Implementation. A survey of industry will be made to determine the state-of-the-art of inexpensive, environmentally safe, high speed molding techniques. Necessary R&D will be completed in FY79. A contractor will be selected for implementation.

e. Technical point of contact for this project is J. Ansell, Autovon 290-2840.

7. Economics

a. Funding

FY77 (6.2)	FY78 (7.8)	FY79 (6.2)	FY80 (MMT)
$20K	$50K	$100K	$240K

b. Economic Analysis. A successful molded module package would result in a packaging savings of about $.20 per fuze. At any one time, one of the M734, M732, or XM587E2/724 fuzes will be in production at a conservative rate of 50,000 per month, yielding an annual savings of $120,000 per year per fuze type.

c. Environmental Effects. The environmental consequences of this project have been assessed and the approved EIA dated 1 May 1978 is attached. No significant environmental effect is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

Project No. H803507(ERADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)
8151

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 12 MAY 1978

1. Project No. H803508 2. PA 5297 3. Cost: $315K
4. Title: MMT, Ceramic-Metal Substrates for Hybrid Electronics
5. Facility/Contractor: Harry Diamond Laboratories/Contractor to be selected
6. Summary:

a. Problem. Thick film hybrid circuitry is presently used extensively in artillery, mortar, and rocket fuzes, and is planned for small caliber (30mm to 40mm) rounds. All of these fuzes are high-quantity, low-cost devices that must survive an extremely high "g" environment. At the present time, all thick film hybrids are fabricated on a ceramic substrate, which is fragile at high-g shock levels, and must be adequately supported in order to survive. The supports are, generally, relatively expensive machined metal parts, which are necessary only because the substrates are ceramic, and are not required for the fuze structure. Elimination of these metal supports will provide a considerable cost savings.

b. Solution. Substitution of a metal substrate, which has been electrically passivated with a ceramic coating, for the present ceramic substrate would allow high-g survivability for thick film hybrid circuits. This new type of substrate would be equivalent in cost to conventional substrates, but would alleviate the necessity for a machined metal support, as the support will be integral with the substrate.

c. End Product. A production process for manufacturing thick film hybrid electronics on a metal-based substrate. The process will be applicable to electronic fuze designs, as well as many non-fuze applications.

d. Implementation. Current R&D efforts will develop a basic process. A contractor will be selected for implementation of the process for production by this MMT.

e. Technical point of contact for this project is J. Ansell, Autovon 290-2840.

7. Economics

a. Funding

FY78 (6.2)	FY79 (6.2)	FY80 (MMT)
$40K	$150K	$315K

b. A successful metal-based substrate process would result in a savings of approximately $.25 per fuze. At any one time, one of the M732 or M734 fuzes will be in production at a conservative rate of 50,000 per month, yielding an annual savings of $150,000 per year per fuze type.

c. Environmental Effects. The environmental consequences of this project have been assessed and the approved EIA, dated 31 March 1978 is attached. No significant environmental impact is anticipated, nor is any environmental controversy expected to be associated with this action. An EIS is not required.

Project No. H803508(ERADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)
8091

Date: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD-1125 (R1)

RECEIVED 12 MAY 1978

1. Project No.: H5803510 2. PA 5297 3. Cost: $250K
4. Title: MMT, Transducer Process Technology for MW Delay Lines.
5. Facility/Contractor: A substantial portion of this work will be done by a contractor to be selected competitively.
6. Summary:

a. Problem: Although microwave (MW) delay lines utilizing thin film piezoelectric transducers have been produced by several manufacturers since 1970, the parameters for describing the actual processes required for high-quality transducers have not been documented. In many cases this lack of knowledge has resulted in production halts or reduced yield. As a consequence, the prices of delay lines have remained unnecessarily high, and the process technology is stalled at the beginning phase of the learning curve.

b. Solution: Document the materials, processes, controls, and techniques necessary to fabricate high-quality thin film piezoelectric transducers. Substrate temperature, sputtering rates, target materials, sputtering atmosphere, cleaning techniques, vacuum techniques, sputtering fixturing, and other parameters will be incrementally shifted in a coordinated program so that a non-critical stable "plateau" region for these processes is defined. The definition of this process will insure high yield production of transducers and will result in much lower production costs.

c. End Product: A report detailing the method to fabricate, evaluate, and control the processes, materials, and techniques will be written and distributed.

d. Implementation: The results of this project will be able to be immediately utilized by the manufacturers of delay lines. Both the XM735 8" nuclear fuze and the Improved Hawk fuze programs will immediately benefit from this work.

e. Technical Point of Contact for this project is Mr. S. Lieberman, Autovon 290-3190.

7. Economics: a. The investments involved in this technology are summarized below:

	FY76	FY77	FY78	FY79	FY80	FY81	FY82
RDT&E	-	-	-	50	-	-	-
MM&T	-	-	-	-	250	250	-
Product Improvement	No product improvement is required						
Implementation	No additional implementation funding is required.						

b. When this MMT program is completed the impact on the cost of delay lines will be an initial cost reduction of 15-25% and an ultimate cost reduction (beyond present prices) several years later of 35-50%. This second reduction is based upon more competitors coming into the market place.

c. The Environmental Consequences of this project have been assessed and the approved EIA, dated is available. No significant controversy expected to be associated with this action. An EIA is not required.

Project No. H5803510 (ERADCOM)

DUPLICATE

EXHIBIT P-16 (Part I)

Date: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD-1125 (R1)

1. Project No.: H803511 2. PA 5297 3. Cost: $525K
4. Title: (MMT) Fabrication of Submicron Photomasks for IC Devices.
5. Facility/Contractor: A major portion of this work will be done by a contractor.
6. Summary:

a. Problem: Existing semiconductor technology limits both HDL and commercial manufacturers to line widths of .8μ, 5mm long using normal production techniques. Integrated circuit and special systems require photomasks with .5μ line widths to increase yield and allow the design of higher frequency devices demanded by military technology. It has been suggested that electron beam systems be used, but they have major problems not the least of which are cost, size of pattern and radiation damage of semiconductor substrate.

b. Solution: Modify existing technology and apparatus to achieve submicron geometries over large area suitable for the production of LSI circuitry and complex acoustic devices. By using shorter wavelength optics it will be possible to improve lens resolution such that submicron pattern of suitable length could be fabricated. The use of shorter wavelength optics would allow the updating of photomasking systems currently used in production extending their useful life; allowing the fabrication of devices not currently within the reach of the technology thus increasing device yield and reducing cost.

c. End Product: Technical reports will be issued showing the modification of the optic system along with the mechanical changes needed to implement the more sophisticated system. The HDL photomasking system would be used as the prototype system for the submicron optics along with related mechanical changes to allow it to be used as a research tool to fabricate masks for fuzing projects requiring high frequency devices and higher yield. State-of-the-art surface wave transducers would also be fabricated and documented.

d. Implementation: There is no implementation cost for the HDL mask making facility. There would be cost to industrial users of this improved technology. This is estimated to be $300K which would be recouped by the users in the production of only 3000K units.

e. Technical Point of Contact for this project is Mr. R. Reams, Autovon 290-3190.

7. Economics: a. The investments involved in the system are summarized below:

	FY78	FY79	FY80	FY81	FY82
RDT&E	50	50	-	-	-
MM&T	-	-	225	200	100
Product Improvement	-	-	-	-	-
Implementation	-	-	-	-	-

b. Economic Analysis of the impact of improved optical photomasking systems shown are impact on many areas. First the cost of producing solid state devices of any kind would be reduced, in the case of simple devices where yield has a small impact the saving could be estimated to be 10% to 15% but in the case of complex LSI circuits yield would have a great impact and the cost might be reduced by as much as 50%. This approach also has the desirable side effect of extending the useful life of existing commercial manufacturing equipment by allowing it to fabricate submicron devices.

c. The environmental consequences of this project have been assessed and the approved EIA, dated is available. No significant controversy is expected to be associated with this action. An EIS is not required.

EXHIBIT P-16 (Part I) DATE: 1 July 78

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD 165 (RI)

1. Project No. H809563 (ERADCOM) 2. PA 5297 3. Cost: $535K

4. Title: MM&T - Miniature High Voltage Power Supplies for 3rd Generation Aviation Night Vision Goggles (ANVG)

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive bidding. The responsible activity for supervising the effort is NV&EOL.

6. Summary: (a) Problem - The 3rd generation aviation NVG will allow for night operations to be extended to overcast starlight levels and eliminate pilot fatigue caused by present 2nd generation NVG by a system weight reduction to .90 lbs. This dictates that the miniature high voltage power supply be made in one-half the allotted volume (0.45 cu. in.) of 2nd generation and meet stringent electrical requirements of providing 7 KVDC to the image tube while also meeting reliability requirements for pilot safety. Current high voltage production fabrication techniques and quality control procedures for the standard second generation power supply are insufficient to achieve the necessary stability and reliability because of packaging density, high voltage gradients and insulation resistance requirements. (b) Solution: The solution is a program to develop miniature high voltage power supply fabrication and processing methods which will provide volume production and high yield. Critical processes for assembly of the miniature high voltage multiplier and transformer with its regulator components and their vacuum encapsulation to control surface leakage to less that one nanoampere at 7 KVDC will be established. A yield improvement to 85% will result by establishing production controls and eliminating production processing variables to achieve uniform low leakage reliable operation. (c) End Products: This project will provide manufacturing and process control technology for producing reliable miniature power supplies for aviation night vision goggles. A quantity of power supplies will be produced on a pilot line to enable demonstration and evaluation of the process. A Final Engineering Report will be distributed to industry. (d) Implementation: The power supply is an integral part of the image tube/power supply assembly module of the aviation NVG and is included in the base line configuration. No additional action will be required after successful completion of the PEM project to obtain a return on investment. (e) Point of Contact: Howard M. Kessler (Autovon) 354-1551.

7. Economics: (a) R&D effort funding (1E263710DK70/01 FY77 through FY79) is planned at $600K. MM&T funding for FY80 is $535K. There will be no additional Government costs to implement the project results. (b) This technology is required for initial production of the Aviation Night Vision Goggles and will significantly reduce the cost of the high voltage power supply integral to the tube assembly. Based upon requirements of approximately 21,000 power supplies over a ten year period after process establishment, an estimated net savings discounted in accordance with AR 11-28 of $4,954,511 will result. (c) The performance of this project will not violate safety standards and will not have an adverse effect on the environment.

Project No.: H809563 (ERADCOM)

EXHIBIT P-16 (Part I) DATE 1 July 78

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT RCS CSCRD 165 (R1)

1. Project No.: H809588(ERADCOM) 2. (PA 5297) Cost: $900K
4. Title: MM&T - Third Generation Low Cost Image Intensifier Tubes
5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility through competitive bidding. The responsible activity for supervising this effort is NV&EOL. 6. Summary: a. Problem: The Army has future requirements for Third Generation Low Cost Image Intensifier tubes ($TGLCI^2$). These requirements include the Low Cost Night Vision Goggles (LCNVG) and planned retrofitting of the AN/PVS-5 Goggles. In addition the technology developed will be applicable to all future third generation programs related to the 18mm and 25mm image intensifiers. The $TGLCI^2$ will be of sufficient quality to allow typical night vision tasks such as driving, walking, patrol and a variety of manual tasks. Third generation tubes are presently completing R&D and are expensive due to a complete lack of a low cost production fabrication techniques and quality control procedures. b. Solution: The procurement cost of the $TGLCI^2$ tube will be reduced substantially thru the effort of this MM&T by the following actions: (a) assembly and vacuum processes will be established and optimized, (b) salvage techniques will be established, (c) minimum quality of components will be established and, (d) quality control procedures and techniques will be established and documented for the total production process. c. End Products: The end products for this effort will be manufacturing methods with established processes and techniques for producing $TGLCI^2$, production line capability, pilot production run, special tooling, and engineering reports. d. Implementation: The concepts and techniques established under this PEM effort will be implemented to establish a competitive production base at a minimum of three manufacturers through directed source initial procurement buys. Thereafter all procurement will be fully competitive and no additional action will be required to realize the full cost savings established herein. e. Point of Contact: Mack Farr (AV) 354-1725. 7. Economics: a. R&D funding (1E263710DK70-01 FY77 through FY79) is planned at $1000K. b. The FY80 funding for this two year MM&T is $900K. c. A typical example of the net savings as a result of this MM&T as applied to the LCNVG is $22,772K with an investment ratio of 27.5. d. The performance of this project will not violate safety standards and will not have an adverse effect on the environment.

Project No. H809588(ERADCOM)

DUPLICATE

EXHIBIT P-16 (PART I) DATE: 21 April 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165(RI)

1. Project No: H809897 (ERADCOM) 2. PA 5297 3. Cost: $300

4. Title: MM&T - Surface Acoustic Wave Resonator and Reflective Array Devices

5. Facility/Contractor: This project will be accomplished at a privately owned plant selected from qualified producers through competitive bidding.

6. Summary: Requirements exist for certain RF devices which are not available or possible due to technological limitations associated with conventional techniques. Bulk crystal devices, for bandpass filter and oscillator applications, are limited to low fundamental frequency (< 50 MHz) operation, which restricts harmonic over-tone operation as well. Linearly dispersive RF filters are very difficult to implement using conventional methods.

Advances in surface acoustic wave (SAW) technology have demonstrated SAW resonator techniques can provide high performance frequency control and high Q filter functions over the VHF-UHF range. Moreover, SAW dispersive reflective array compressors (RAC) have demonstrated outstanding performance for operation as high as 500 MHz.

The proposed program would establish the necessary fabrication/production techniques to achieve pilot-line capability to produce SAW reflective array devices applicable to frequency control, band-pass or dispersive filter functions. The program would formalize the acoustic groove reflector production process and define device reproducibility, reliability, costs and performance limitations using ion-or plasma-etching. The program would demonstrate production of SAW reflective array devices operating at 70 and 300 MHz; the program would also establish manufacturing and quality control processes to meet a specified production rate. Reports detailing production methods will be distributed to the industry along with a detailed presentation of program results at the conclusion of work. Proponent Engineer: E. Mariani (AV 995-2647)

7. Economics: Previous Government R&D expenditure directly related to this program total $500K; no previous PEM project concerning SAW reflective array devices has been funded nor is any future PEM funding anticipated. Upon completion of proposed effort, improved reproducibility and reliability will significantly reduce device cost-nearly ten-fold-so that SAW resonators now costing $500 ea. (small qty.) would cost $50-100 ea. and RAC's costing $5-10K (small qty.) would cost < $500. Using discount procedures mandated under AR11-28, a net present value savings approximately $5,948,000 over and above the project cost is calculated. The execution of this program will not have a significant impact on the quality of the environment.

DUPLICATE

EXHIBIT P-16 PART I

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

Date: 1 Jul 78

RECEIVED
5 JUL 1978

1. Project Nr R801023 (MIRADCOM) 2. 2597 3. Cost: .300M

4. Title: Digital Fault Isolation for Hybrid Microelectronic Modules

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: The trend toward increasingly dense military digital electronic system requires a significant improvement in digital fault isolation capability for hybrid microelectronics in order to prevent major increases in fault isolation costs and schedule delays due to the potential manufacturing bottlenecks created by faults. Hybrid modules are increasingly complex and prone to high failure rates. The testability of hybrid modules is low due to the multi-chip fabrication techniques. Very often a problem cannot be diagnosed without internal probing. (b) Solution: Two new techniques for digital fault isolation have appeared in the last few years. The first to appear was based on digital simulation of faults and led to a fault dictionary relating faulty output states to faulty devices. The newer method, known variously as "Probe Trace" or "Back Trace", utilizes the logical interconnections of the circuit and the "good" state of all accessible circuit modes, for each test step, to provide a guide for determinating fault isolation. The Probe Trace approach is generally much more thorough, can be automated, and allows more efficient utilization than the Fault Dictionary approach. It gives good results even in situations of multiple faults. This project would develop a manufacturing technology for employing the Probe Trace method for fault isolation in the production of hybrid microelectronic modules. (c) End Products: This project will include: (1) manufacturing data and guidelines for fault isolation test specifications, equipment, software requirements, and operational data; (2) technical reports on detailed testing methodology, techniques, procedures, and program results; and (3) the military specifications for testability of hybrid microelectronic modules will be analyzed and developed. (d) Implementation: After successful completion of this project, action will be taken to disseminate results to project managers, other government agencies and industry. The project managers will be kept abreast of the progress of this project and will be requested to implement the benefits of this program.

7. Economics: This project will cost .300M in FY80. The economic analysis for this project is based on a yearly manufacture of approximately 166,000 Army hybrid microelectronic modules as an average cost of $150 per module. This project will result in a 30 percent reduction in present digital fault isolation costs with a savings of $450,000 per year. Execution of this project will not adversely affect the environment.

EXHIBIT P-16 (PART I)

DUPLICATE

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

RECEIVED 5 JUL 1978

1. Project Nr R801024 (MIRADCOM) 2. 2597 3. Cost: .128M

4. Title: MM&T Radio Frequency Stripline Hybrid Components

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: The natural evolution of the stripline technology is to integrate within the stripline element discrete components both active and passive. Integration of discrete devices, which includes diodes, FET's, circulators, attenuators, resistors, capacitors, loads, connectors, etc, presents problems of symmetry and conformity in placement, assembly and interconnection techniques. The engineering design aspects of these considerations have been addressed and predictable design guidelines have been established. The application of this hybrid stripline assembly process results in smaller, less expensive, lower weight subsystems which are of increased performance and higher reliability due to the integrated nature of the assemblies and reduced testing required. (b) Solution: To accomplish this in production, a manufacturing methods program is required. This program will establish the requirements, processes, quality assurance, and limitations of placement, assembly, and interconnection for incorporating discrete components integral with RF stripline components including, as applicable, the use of automated component placement using developed or modified leadless carrier placement. (c) End Products: The integration of active devices and other circuit elements into the stripline itself will eliminate the severe interfacing problems existing with present techniques. Elimination of external discrete components and the subsequent problems of interconnection will substantially reduce the costs associated with stripline elements. (d) Implementation: The results of this project are of generic applicability to all DOD, NASA, defense and commercial contractors, and will be disseminated to all interested agencies. This technique will result in considerable reduction in acquisition costs and costs of ownership of applicable RF systems.

7. Economics: This project will cost .128M in FY80, .256M in FY81, and .153M in FY82. Cost reduction resulting from this project is estimated at a 60 percent reduction in cost from an estimated $600 per unit cost. Other intrinsic benefits will be reduced size and weight and improved reliability. Not included in the above is the elimination of the need for complex and expensive rotary joints and other components now needed for "off-gimbal" type RF packaged systems. Execution of this project will not adversely effect the environment.

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

Date: 1 Jul 78

1. Project No. R801028 (MIRADCOM) 2. 5297 3. Cost: $.2M

4. Title: MM&T - Optimized Computer Thermal Analysis of Hybrids and P.W.B.

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: The trend in military electronics is for highly dense packaging techniques with an inherent increase in power dissipation and need for heat removal. This thermal stress of semiconductor and other components is directly related to component value drift and more importantly - reliability. There are a variety of computer programs available for use in thermal analysis of hybrids. Most of the very thorough programs, such as CINDA, are cumbersome and not well adapted for use with hybrid thermal analysis. Some of the others have questionable accuracy. "Burn-in" tests require high thermal stress for relatively short periods of time; however, there is a maximum temperature for semiconductor components that should not be exceeded. Hence, there is a great need for an optimized accurate, efficient, standardized program that maximizes the programmer's effectiveness. (b) Solution: Adapt and optimize the most effective program available for use in the manufacturing environment for proper selection of heat transfer techniques and materials. (c) End Products: This project will result in (1) a deliverable, optimized hybrid thermal analysis program in a widely used higher-order language; (2) technical reports on detailed theory of operation, test results of accuracy and program results; (3) a users manual that will allow ease of use. (d) Implementation: Project Managers will be notified of the availability of this software. Technical presentations and technical reports will be sent to appropriate technical societies.

7. Economics: This program will cost $.2M in FY80 Cost savings as a result of completion of this project will be primarily due to a reduction of test time and the expected increase in product reliability. The military uses several million hybrids and P.W.B.s a year and it is estimated that for hybrids alone a 20 percent savings can be achieved.

The execution of this project will not have a significant effect on the environment.

Project No. R801028 (MIRADCOM)

DUPLICATE

EXHIBIT P-1 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

RECEIVED
5 JUL 1978

DATE: 1 Jul 78

1. Project No. R801030 (MIRADCOM) 2. 2597 3. Cost: $.229M

4. Title: MM&T Automatic Test, Mounting and Stacking of Locasert - Non-Axial Devices

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Development of the "Locasert" insertion aid (MM&T Project No. 3225 - Contract DAAK01-76-C-1086) has resulted in a cost-effective improvement that lowers insertion costs for full manual, machine-aided, or fully automated levels, even with hand loading devices into "Locaserts"; savings of 30% of unaided manual costs are feasible with "Locasert" aided automatic insertion. An added 10% savings can be made with automated test, "Locasert" mounting, and stacking of devices in loading magazines (sticks) to eliminate hand labor. (b) Solution: Build a production system (1) to detect orientation of transistors, dips, and hybrid devices electrically; (2) to rotate and position the devices for insertion into Locaserts; (3) perform functional testing; (4) insert devices into Locaserts; and (5) load into sticks for insertion machine. (c) End Product: The end product will be the technology to functionally test non-axial lead devices automatically and load known good devices mounted in Locaserts in sticks ready for automatic insertion into printed wiring boards. (d) Implementation: After successful completion of this project, action will be taken to disseminate the information obtained to project managers, other commands, and other services. "Locasert" aided insertion is being bid on several future contracts by Martin-Marietta, Orlando. The "Locasert" automatic insertion machine is under consideration as a commercial sales item. The complete system, "stick" loader, and insertion machine, will be self implementing.

7. Economics: The "Locasert" aided insertion systems are the most cost effective insertion systems yet developed; even with manual loading of "Locaserts," it is cost-effective for Locasert-aided manual insertion and all stages of machine-aided insertion to full automatic insertion, and will improve its cost effectivity if automated magazine "stick" loading of "Locasert" mounted devices is developed to eliminate the manual "Locasert" loading operation. (a) This project will address the problem of combining device testing, orientation, and "Locasert" loading into one machine cycle. The output will be "sticks" of known good devices oriented correctly for rapid,precise insertion in printed wiring boards by manual or machine methods. (b) 40% savings in insertion costs per board is a conservative estimate of the cost advantage of automated machine "Locasert" aided, over manual methods; if the proposed testing and"Locasert" loading system is developed and used. FY80 - .229M and FY81 - .229M. Execution of this project will not adversely effect the environment.

Project No. R801030 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM)
RCS CSGLD 1125 (R1)

RECEIVED 5 JUL 1978

1. Project No. R801031 (MIRADCOM) 2. 2597 3. Cost: .230M

4. Title: MM&T - Eliminate Gold on Printed Wiring Board Edge Contacts

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Most commercial and many military printed wiring boards use on-piece board-edge connectors. Increasing numbers of such boards are used in military systems. Gold over nickle is standard for high reliability circuits; gold adds nearly a dollar to the cost of each connector; since to the intrisic cost of gold is added a labor-intensive plating process for card-edge contacts. (b) Solution: (1) Plate connectors with a less expensive metal or alloy. Palladium, tin-nickle and nickle, either with or without tin or indium as a lubricant will be evaluated as a direct replacement for gold; having equal reliability. (2) Using the developed metal system, investigate the application of high speed "pulse plating" to the edgeborad contacts. Design and optimize tooling to be used for repetative plating of card edge contacts with the minimum of labor, thus achieving improved quality at lower costs. (c) End Products: The end products of this project will be (1) a base metal system to replace gold on card edge contacts, (2) a high-speed automated process for plating card edge contacts with the selected metal system; with special equipment, tooling and instrumentation requirements; a full set of reports, manuals, drawings and all documentation to allow ease of duplication of equipment and results. (d) Implementation: After successful completion of this project action will be taken to disseminate results to project managers, other commands, and to various suppliers.

7. Economics: This project combines proposed MM&T Project No. 3265, "Eliminate Gold on Printed Wiring Boards Edge Contacts" and proposed MM&T Project No. 1031, "High Reliability, High Speed Plating of Card Edge Contacts" This project will cost $.230M in FY80, and $.240M in FY81. The following estimate is based on a known usage of more than 8,000,000 boards per year. The cost of plating edge card contacts is more than $1.00 per board. A cost saving of 80% can be expected; the savings to be expected is $6,400,000 per year over an expected ten year service life. This does not include the added potential of savings if the gold universally used on pins and sockets in cable connectors were replaced.

DUPLICATE

EXHIBIT P-16 (PART I)

DATE: 1 Jul 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803081 (MIRADCOM) 2. 2597 3. Cost: $.150M

4. Title: MM&T - Production of Radar Monopulse Seekers Using Printed Circuit and Stripline Techniques

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: The fabrication of present seeker antenna arrays involves expensive and time consuming precision machine work. Equivalent components have been developed using stripline technology, but operating at a different frequency from that needed in this application. (b) Solution: To establish manufacturing methods and processes for fabrication of flat plate four quadrant, slot array antennas, associated hybrid networks for forming sum and difference patterns of signals received and the receiver front end using high accuracy printed circuit and stripline techniques to provide smooth surfaces on low loss materials and sufficiently low standing wave ratios. This will be applicable to antenna using rectangular, conical, parabolic and other geometries. (c) End Products: This project will be new materials processing techniques and manufacturing methods for microwave striplines including: (1) manufacturing data which will consist of data for hybrid and P.C. microwave stripline specification, equipment requirements, software requirements, and operation data, (3) technical reports on detailed quality control procedures and program results. (d) Implementation: After successful completion of this project, action will be taken to disseminate results to project managers, and other Commands. The project managers will be requested to implement the benefits of this program.

7. Economics: This project will cost .150M for FY80 and .200M for FY81. The economic analysis for this project is based on future mission requirements. The cost in small quantities for seeker monopulse antennas is $1500 and in large quantities $1200 each. With MM&T the cost can be reduced to approximately $500 each. Execution of this project will not have a significant impact on the environment.

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EXHIBIT P-16 (PART I) DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
RCS CSGLD 1125 (RI)

1. Project No. R803139 (MIRADCOM) 2. 2597 3. Cost: $.350M

4. Title: Production Methods for Millimeter Seekers for Terminal Homing (TH) Applications

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Achieving required precision in making the steps in a dielectric lens, and establishing and maintaining the alignment between the backside of the lens and the front of the nutating millimeter horn feed are difficult fabrication problems that must be solved if the millimeter terminal homing seekers are to be made in moderate quantities at a reasonable price. The cost of the present seeker, which is made on a one-at-a-time basis is also increased by the amount of hand work that must be done on the transmitter receiver assembly. The electronic section of the seeker is not part of this program. (b) Solution: (1) Provide an alignment and test fixture to speed the assembly and test of the lens-horn gimbal assembly; (2) establish a method of molding the steps in the lens with the required precision; (3) apply photolithographic techniques to reduce the amount of hand work in fabricating the transmitter receiver assembly. The first phase will be devoted to establishing these prcesses individually, and the second phase will integrate these into a pilot line for production and validation of 10 complete seekers. (c) End Products: The end products includ 10 seekers made by the new manufacturing methods and a final report describing these new processes. (d) Implementation: The results will be provided to industry and to other government agencies having a need for this technology.

7. Economics: (a) R&D effort is performed under DA Project No. 1M362303A214. Total funding to date is approximately 1.800M; MM&T funding: FY80 - .350M; FY81 - .250M. (b) The objectives are to reduce cost and increase performance of seekrs. The improved seeker will provide sensors for TH weapons capable of killing hardpoint targets to ranges of at least 40Km. In addition to broadening the production base, benefits to the Government are: (1) weight reduction for increased payload, (2) reduced life cycle costs, (3) improved reliability and (4) benefit to other programs in sensor technology. Without MM&T, the estimated cost of the antenna and electronics unit is $300 and $2600 each, respectively, with an estimated total seeker cost of $6100 each for production rates of 150 per month. With MM&T, the estimated cost of the antenna and electronic unit is $30 and $850 each, respectively. Assembly and test can be reduced from $200 without MM&T to $100 with MM&T for each seeker unit. These savings are based upon the same production rates.

Project No. R803139 (MIRADCOM)

DUPLICATE

EXHI[illegible]T

DATE: [illegible] Jul 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)

RCS CSGLD 1125 (RI)

1. Project No. R803186 (MIRADCOM) 2. 2597 3. Cost: $.500M

4. Title: Improved Manufacturing Processes for Infrared Indirect Fire Seekers

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected:

6. Summary: (a) Problem: The fabrication of a two-color infrared seeker for land combat imposes more severe criteria in the selection of optical materials, more critical alignment procedures for the optics, and greater difficulty in the fabrication of the two-color sandwich detector than the fabrication problems of earlier infrared seekers. Present techniques involve high labor costs to produce prototype hardware on a one-at-a-time basis. (b) Solution: Improvements in manufacturing processes for gyro rotors, gyro optics, sandwich detectors, and dewar cryostat assemblies in the areas of material selection, replication techniques, and machining of rotors of this category of infrared seekers will be accomplished to up the yield rates and reduce cost. The infrared seeker as part of a submissile or artillery round will provide the Army with an improved "fire and forget" capability for indirect fire, surface-to-surface missiles. New production techniques are required to produce these seekers in quantity. (c) End Products: End products of this project will include written reports and demonstrations of (1) techniques for material selection, (2) manufacturing processes producing high yields, (3) proper handling and storage devices, and (4) automated assembly and checkout procedures required to minimize failures. (d) Implementation: After successful completion of this project, action will be initiated to disseminate results to project managers, other commands, and other services. Special emphasis will be placed on applicability to those items scheduled for production. The project managers of GSRS, CAWS, and other applicable systems will be kept abreast of the progress on this project and will be requested to implement the benefits of this program.

7. Economics: (a) The R&D related effort has been conducted under DA Project 1M362203A214. The overall R&D funding to date is approximately 1.800M. The MM&T investment is: FY80 - .500M, FY81 - .450M. (b) The objectives are to reduce cost and to increase availability of infrared seekers. Benefits to the government fom improved manufacturing methods and technology in this area include: (1) reduced life cycle costs, (2) broadening of the production base, (3) improved end item reliability, (4) improved service life, (5) automated checkout, and (6) benefit to other programs in infrared technology. In small quantities without MM&T, the cost of an infrared seeker is $4500. Without MM&T, the cost can be reduced to $4000 in larger quantities. With MM&T, this cost can be further reduced to $35000. (c) The execution of the project will not have an adverse effect on the environment.

DUPLICATE

EXHIBIT P-16 (PART II)

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
RCS CSGLD 1125 (R2)

1. Project No. R803189 (MIRADCOM) 2. 2597 3. Cost: 2137PM

4. Title: MM&T Improved Manufacturing Processes for the CO_2 Beamrider Guidance Optics

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Establishing and maintaining the alignment of the optical elements of the zoom assembly, and providing the criteria for selection ofthe optical material at 10.6 microns must be solved if the CO_2 beamrider guidance optics is to be produced in moderate quantity at reasonable costs. There are no suitable methods for fabrication, assembly and test of the receiver-dewar unit, which must be done by hand. The CO_2 laser which is part of the guidance assembly is not part of this project but is covered by the ERADCOM project in FY-80. This CO_2 beamrider guidance optics assembly has been produced in R&D prototype form from technical feasibility demonstration but has not been produced in quantity. (b) Solution: An optical assembly and test fixture will be made to speed the assembly and test of the zoom optical elements specification for selection of the lens material will be established. Based on a redesign effort now in progress, fabrication and assembly methods for the receiver-dewar unit will be defined and validated to increase the yield rate of the detector and automate as far as possible the assembly and test of the overall unit. The principal source of savings in this project is expected to be in labor costs. (c) End Products: The new manufacturing processes will be applied to produce prototype units for test and evaluation. A final report will be prepared describing the new processes. (d) Implementation: The results of the program will be made available to the prime contractor producing this item in quantity as well as to the industry at large.

7. Economics: (a) R&D related effort is being performed under DA Project 1M362203A214. Overall R&D funding to date is approximately 3.000M. MM&T funding is FY80 - .375M FY81 - .400M. (b) The objectives are to reduce cost and improve the reliability of the zoom optics transmitter for beamrider guidance. Benefits to the government from improved manufacturing methods and technology in this area include : (1) reduced life cycle costs, (2) broadening of the production base, (3) improved end item reliability, (4) improved service life, (5) automated production processes, and (6) Advancedment of the optical manufacturing art for both military and civilian application. In small quantities without MM&T, the cost of the zoom optics transmitter is $15,000. In larger quantities the cost is $10,000. With MM&T the cost can be reduced to $5000. (c) The execution of the project will not have an adverse effect on the environment.

Project No. R803189 (MIRADCOM)

EXHIBIT P-16 (PART I)

DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803214(MIRADCOM) 2. 2597 3. Cost .400 M

4. Title: MM&T - Injection Molding Electrical Connectors and Cables with Polyurethane

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary:

a. The Problem: Strain relief potting and molding, and environmental sealing of electrical cable and of contractor assemblies is costly. The reason for this is repetitive manual labor. The use of liquid cast thermosetting compounds is not a good solution because this use involves high labor and materials costs for the necessary hand processing. b. *The Solution: It is proposed* to undertake and injection molding development effort which will identify the materials, tooling criteria, connector combinations. The effort will be divided into four tasks. (1) A demonstration of the injection molding technique on selected cable connector configurations--with a cost analysis. (2) The establishment of design, fabrication, and molding process guidelines for cable/connector hardware molding. (3) The establishment of qualification methods which are tailored for injection molding only, rather than the current thermosetting liquid potting criteria. (4) The assembly and molding of cabling for currently used hardware and physical evaluation and cost analysis of the same. c. End Products: The end products will include (a) Technical reports which give the complete results of all experiements, along with conclusions and recommendations, (b) All specialized equipment purchased or constructed for the project. d. The Implementation: After successful completion of this project action will be required to disseminate results to project managers, other commands and other services.

7. Economics: Industry is responsible for practically all R&D efforts that have been expended in this area, with little, if any, attention to military uses. The project costs for FY80 total .400M, which in turn should provide a savings of $3,175K projected over five years. The execution of this project will not have a significant effect on the environment.

Project No. R803214 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART ...)

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

DATE: 1 Jul 78

1. Project No. R803241 (MIRADCOM) 2. 2597 3. Cost: .600M

4. Title: MM&T Automate X-Ray Readout and Provide 3D X-Ray Capability

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: X-ray inspection is a universal nondestructive test tool in material and parts testing. Among failure mechanisms detected are solder balls, broken/displaced leads, lifted pads, In structures, defective welds, improperly assembled devices, and fatigue cracks are among defects found. X-ray inspection is invaluable in the inspection of mechanical and electro mechanical devices, X-ray is flexible, and has tremendous growth potential. A relative newcomer to nondestructive testing, neutron radiation testing, is also growing rapidly in importance. Most structural metals are highly transparent to neutrons, and organic materials extremely opaque. Fluxes and lubricants are easily found by N-radiography, even through heavy sections of metal. These contaminants are the most common causes of failure and erratic performance in component parts, sealed electromechanical devices, and one-shot devices. (b) Solution: X-ray and neutron radiation are easily viewed by television systems. The standard system is 525 line (broadcast) resolution: This is inadequate for nondestructive testing; but an upgraded T.V. system with a resolution of 1050 lines is feasible and can be assembled from largely commercial parts. Such systems, having four times the area resolution of the broadcast format, are little used because they require four times the input radiation required for 525 line scan. A new scintillator overcomes this problem. This device, obtainable on special order, is a fiberoptic scintillator. The fiberoptic scintillator is many times as efficient at converting input radiation into light as presently used devices, with ample resolution to support a thousand-line scan. This will allow the new 1000 line television to image in much lower input X-ray than any X-ray television system today; and will allow neutron imaging with a generator instead of an atomic pile. (c) The End Product: The end product will be a fully documented X-ray and neutron radiographic television system, convertible within minutes to either input; with a nominal 1000 line resolution, optimized for inspection. The system will have a direct viewing capability, and state-of-the-art image processing with both digital and analog methods. Provision will be made for permanent photographic recording. (d) Implementation: After successful completion of the project, the project is expected to be self-implementing, and to be manufactured commercially, with a potential of several hundred systems, of varied sophistication, to be produced per year.

7. Economics: This project will cost .600M in FY80 and .552 FY81. Economic analysis is based on two systems over a ten year service life, and a requirement for inspecting 50,000 missile systems per year. Conventional radiographic inspection would exceed $100 each, or $50,000,000. X-ray and neutron radiography with direct viewing coupled with computer assistance will reduce cost by two-thirds, or $33,330,000. Execution of this project will not have a significant impact on the environment.

Project No. R803241 (MIRADCOM)

DUPLICATE

EXHIBIT E-15 (PART I)

DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project Nr R803254 (MIRADCOM) 2. 2597 3. Cost: .425M

4. Title: MM&T Low Cost Semi-Flexible Thin Film Semiconductors (CAM)

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: Future missile systems will mandate electronic systems far more complex and higher in density than can be produced by foreseeable advances along established paths of electronic packaging technology. (As an example: If existing devices are to become small and complex enough to serve the projected requirements, circuit elements in the submicron size ranges must be developed. This will be beyond the capability of means used to generate the one micron accepted as a practical limit at present.) A second area of concern is the exceedingly low volumetric efficiency of the current hermetic seal packages for conventional microelectronics, as required for military system reliability. These oversize packages require large, heavy printed wiring boards and large clearances between boards. The resulting electronic systems are heavy, and occupy excessive volumes of increasingly valuable space. (b) Solution: Develop an all thin-film microelectronic technique that is water immune, deposited on a flexible substrate. A compatible thin-film technology is available that produces resistors, capacitors and active devices, using techniques that may be highly automated for consistent reproducibility and low cost. This type of circuit, covered by a conformal coating for mechanical protection, adds only a few mills to the substrate thickness. This type of package will have the capability of being rolled up and cemented into a spiral wound cylinder having many times the package density possible with any presently visible advance in existing packaging techniques. (c) End Products: The end products of this project will be the equipment and technology to manufacture circuitry of the type described by computer controlled automated equipment at high yield, close tolerances, and inherent economy of production. After successful completion of this project, action will be taken to qualify the devices to a suitable MIL or MIS specification for use in existing and future designs. (d) Implementation: Action will also be taken to disseminate results to the various project managers, other services and agencies.

7. Economics: There have been no previous government expenditures in this area of effort. Prior government effort was in development of thin-film transistor driven solid state video displays under contract DAAB-R-C-0061, USA-ECOM, Ft Monmouth, contract F33615-72-C-2013, AF Avionics Lab, WPAFB, Dayton, contract N00014-71-C-0269, Office of Naval Research, Washington. This project will cost .400M in FY78 and .425M in FY80. Estimated 50% less costly semi-conductor devices used in guidance systems, over an 8 year service life, should result in total savings of $7,632,000. This project will have no impact on the environment.

DUPLICATE

EXHIBIT [illegible]-16 (PART I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECTS DATE: 1 Jul 78

TCS CSGLD 1125 (R1)

RECEIVED 5 JUL 1978

1. Project No. R803263 (MIRADCOM) 2. 2597 3. Cost: .250M

4. Title: MM&T Manufacturing Technology for Printed Wire Boards Utilizing Leadless Components

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: a. Problem: Due to the use of large discrete components in present manufacturing methods for printed wire boards, the assemblies are large and awkward; utilizing more space then desirable. They are also not as reliable as would be desired due to the large number of interconnections. The leads inserted through the holes in the boards are a source of problems due to insufficient solder wetting in the hole, trapped flux which can cause corrosion problems, and the large amount of metal located in these holes. Thermal gradients can often cause cracking of the metal in the through hole and subsequent failure. The leads on discrete devices often cause problems because of their length and weight and are easily broken or pulled from the components. b. Solution: Ulitizing leadless components presently available today, the average printed wire board using discrete components can be reduced in area by a ratio of 10:1. Since the leadless components have no leads, plated through holes are eliminated except for interconnecting the layers of multilayer boards, thereby reducing cost and increasing yield and reliability. Further cost reductions are afforded at the individual assembly level since the fabrication is essentially a bath process with solder cream screened on the top only of the printed wiring board and components positioned automatically with tape controlled vacuum pickup equipment. Then the entire assembly is reflow soldered as the final fabrication step. This project will establish the manufacturing technology to fabricate, test, and inspect printed wire assemblies that use leadless components. c. End Product: This project will include: (1) manufacturing data which will consist of data for processing specifications, material requirements, equipment requirements, processing data, and quality control data, (2) technical reports on detailed manufacturing processes, test steps and procedures, and program results, (3) assemblies and components for evaluation by MIRADCOM, demonstration of process. d. Implementation: After successful completion of this project, action will be taken to disseminate results to project managers, and other commands and services.

7. Economics: This project will cost .250M for FY80 and .250M for FY81. The economic analysis is based on present and future requirements of 30,000 printed wire board per year. The present cost of typical printed wire boards is approximately $400.00 per unit. With MM&T this would be reduced to $320.00 per unit or a total savings of $2,400,000 per year. Execution of this project will not have a significant impact on the environment.

Project No. R803263(MIRADCOM)

EXHIBIT P-16 (PART I)

DUPLICATE

DATE: 1 JUL 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803267 (MIRADCOM) 2. 2597 Cost: .200M

4. Title: MM&T - Production Process for Removing Epoxy Smear in Plated-Through Holes

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: A major cost factor in producing high reliability printed wiring boards is the removal of epoxy smear prior to plating through holes. This is currently done by vapor honing. The vapor honing process however, is seriously limited by the hole diameter/board thickness ratio and by the significant dimensional growth that it causes in the boards. Systems supported by this project would be PERSHING, LRGM, PATRIOT, IMP. HAWK, ATI, STINGER, ALT, CHAPARRAL, ROLAND, COPPERHEAD, GSRS, TGSM, DRAGON, and TOW. (b) Solution: It is proposed to utilize a radio frequency plasma (gaseous ion) etching system to remove the epoxy smear in drilled holes. It has been demonstrated that such a system which has previously been used extensively to clean silicon wafers, will economically remove epoxy from drilled holes in circuit boards without visible attach on the copper. An added advantage is that electroless copper deposits directly on the etched epoxy surface, simplifying subsequent through-hole plating. The proposed effort would be directed primarily at increasing the speed of the overall etch cycle to reach production rates with an already proven process. (c) End Products: The end products will be (1) technical reports giving the results of all experiments, conclusions and recommendations. (2) design drawings and specifications for a production-rated radio-frequency plasma etcher for removing epoxy smear from drilled holes in printed wiring boards, and (3) a completely operational prototype of a production-rated etcher for cleaning epoxy smear from drilled holes in printed wiring boards. (d) Implementation: After successful completion of this project, action will be required to disseminate results to project managers other Commands, and other services.

7. Economics: This project will cost FY79 .200M, FY80 .200M. The savings are estimated at 1616K total. The execution of this project will not have a significant impact on the environment.

Project No. R803267 (MIRADCOM)

DUPLICATE

RECEIVED 5 JUL 1978

EXHIBIT P-16 (PART I) DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

1. Project No. R803411 (MIRADCOM) 2. 2597 3. Cost: $.220M

4. Title: MM&T - Manufacture of Non-Planar Printed Circuit Boards

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Missile system electronics are based on flat printed circuit boards. Since flat boards are incompatible with circular, drum shaped compartments, undesirable trade-offs are forced. Several printed wiring boards have to be manufactured and assembled to reach the circuit densities required for an average guidance system. These result in close packing of many small boards, complex and expensive interconnections, with consequent lowered reliability and high cost. (b) Proposed Solution: Produce non-planar printed circuit boards shaped to fit the available compartments. In a typical guidance system, the board would be a tube of glass-reinforced plastic, clad with copper. Circuit patterns could be exposed on the inside of the board with a projection mechanism or with soft x-ray. Mass soldering of components can also be done. This type of board would have several times the surface area of any possible flat P.C. board that would fit the available space, and will use less volume than an equivalent assembly of several flat boards. The interconnect problem will be lessened and costs lowered as the functions of several small, flat boards are placed on one large board. (c) End Product: The end product will be a methodology for manufacturing non-planar printed circuit boards, a technology for parts assembly to such boards, and interconnect techniques. (d) Implementation: The managers of applicable projects will be informed of the results of the project upon successful completion.

7. Economics: (a) There have been no known government or industry R&D efforts in this area. This program will cost $.220M in FY80 and $.550M in FY81. (b) If adopted, one guidance electronics system cost can be reduced by approximately $30. One applicable missile, COPPERHEAD, has a production potential of over 100,000. The use of non-planar boards would mean a savings of $3,000,000 with this number of missiles. (c) This project will not have an adverse effect on the environment.

Project No. R803411 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)

RCS CSGLD 1125 (RI)

1. Project No. R803427 (MIRADCOM) 2. 2597 3. Cost: .450M

4. Title: MM&T, Improved Manufacturing Techniques for the MultiEnvironment Active Seeker

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Fabricating the dual-polarized antenna array and comparator of the multienvironmental active RF seeker in quantity so that cross-coupling is minimumized is one problem that must be solved if these units are to be produced in quantity at moderate cost. Furthermore, there is no suitable production test procedure to quickly check the performance of this assembly against the manufacturing tolerances. Lower cost fabrication methods and production test procedures are also needed for the IMPATT diode transmitter assembly. (b) The solution: Manufacturing processes will be established that provide for the IMPATT diode array transmitter and polarization diversity antenna to be made as a single unit, thus reducing the need for cables to connect the two units. This process will at the same time reduce cost and complexity and improve reliability. Manufacturing processes will also be established for the receiver to reduce the number of assembly steps, and provide better control of performance. (c) End Products: Prototype hardware will be made with the new manufacturing methods and a data package produced describing the new processes. (d) Implementation: The results of the effort will be provided to industry at large including the prime contractor producing the items in quantity.

7. Economics: (a) The R&D funding on this project to date is 1.400M from DA Project (M362203 (A-214)). The MM&T funding is: FY-80, .450M; FY-81, .500M. Benefits to the Government from improved manufacturing methods and technology on this project include: (1) Reduced life cycle cost, (2) Broadening of the production base, (3) Improved end item reliability, (4) Improved service life, and (5) Benefits to other programs featuring similar antennas and signal processing methods. (b) The cost for fabrication of the first unit is estimated to be approximately .085M. In small quantities without MM&T and in larger quantities this can be reduced to .025M each. With MM&T, the resultant savings primarily in labor costs will allow the seeker to be produced for .008M each. (c) The execution of this project will not have an adverse effect on the environment.

Project Nr. R803427 (MIRADCOM)

EXHIBIT P-16 (~~PART I~~) DUPLICATE

Date: 1 Ju[illegible]

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

1. Project Nr ~~R803435~~ (MIRADCOM) 2. 2597 3. Cost: .350M

4. Title: MM&T Simplification of High-Power Thick Film Hybrids

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: In high power hybrid circuits, adequate cooling of semiconductor power devices is usually achieved by eutectically bonding them to beryllia or metal heat sinks, and by providing the associated interconnection pattern and low power components on separate alumina-based hybrid substrates. At present, this complex and expensive technique is used only on limited production items since no large scale manufacturing process has been developed for using beryllia substrates exclusively. (b) Solution: It is proposed to combine the heat sink and interconnect junctions of power hybrids on single beryllia substrate. Laboratory processes for beryllia hybrids have been demonstrated, but these processes as well as appropriate facilities must be further developed for suitability in a manufacturing environment. To achieve this aim, a manufacturing process will be developed to screen and fire thick film inks onto beryllia surfaces. Commercial inks will be evaluated for their compatibility with beryllia, and firing and handling processes will be developed which take the toxicity of beryllia into account. This includes the co-development of a laser trimming facility which is capable of handling toxic vapors. (c) End Product: This project will demonstrate and document a safe production process for thick film power hybrids utilizing single beryllia substrates. Prototype devices utilizing these manufacturing methods will be provided. (d) Implementation: After completion of this project, action will be taken to disseminate results to project managers and other commands and services.

7. Economics:

a. There has been no previous government expenditure in this effort. This project will cost .350M in FY80.

b. Through simplification of the structure of high power hybrids, cost savings of 15 percent can be realized. This represents a total cost savings of $1,500,000 per year, based on 100,000 devices per year.

c. This project will have no significant effect on the environment and is not in violation of any recognized safety standard. Proper consideration will be given to dust collection, filtering, and venting. Methods of handling beryllia dust are well known and will be applied.

Project Nr R803435 (MIRADCOM)

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (RI)

1. Project No. R803436 (MIRADCOM) 2. 2597 3. Cost: $.250M

4. Title: MM&T for Development of Ceramic Circuit Boards and Large Area Hybrids

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: Advanced weapon systems now require greater complexity and packaging density than can be produced by conventional technology with suitable cost and reliability tradeoffs. Indications are that the development of large scale hybrids (LSH) will be necessary to meet present and future requirements for electronic systems. Manufacturing problems such as hermetic sealing of the package, construction for heat dissipation and screening techniques for large areas are to be overcome. (b) Solution: Development of LSH will provide high density electronics packaging with increased reliability due to reduction in the number of substrates and interconnections. Several substrate and ceramic base circuit board configurations would be investigated to achieve integration at the system level through LSH. (c) End Products: Prototype LSH systems, material samples, complete design documentation and process data necessary for production of LSH modules will be provided as a result of this effort. (d) Implementation: Upon successful completion of this effort, project managers and other services and organizations will be full informed.

7. Economics:

a. There has been no previous government expenditure in this effort. This project will cost .350M in FY78 and .250M in FY80.

b. The cost of the advance electronics system is estimated to be reduced 20% or more by using LSH technology. If LSH were adopted where economically feasible in the applicable missile systems, a cost savings of $8,000,000 per year would result.

c. This project will have no adverse effect on the environment.

Project No. R803436 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I) DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803444(MIRADCOM) 2. 2597 3. Cost: .200M

4. Title: MM&T - Fully additive Manufacturing for Printed Wiring Boards

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: a. Problem: Missile system electronics are based on etched printed wiring boards, in which wire patterns lare etched from copper preclad on reinforced plastic substrates, resulting in a 90% waste of scarce copper, a long, involved production process, and high costs. b. Solution: Produce printed wiring boards by a fully additive process starting with bare (unclad) board, the wiring patterns are built up only where desired, using electroless metal deposition systems. The processing required to produce fully additive boards is simpler than that for etched boards, resulting in a more cost-effective manufacturing procedure. The fully additive boards produced will be capable of meeting or exceeding requirements for military grade boards, at lower costs than present boards. c. End Product: The end product will be procedures and methods by which military grade printed wiring boards may be produced routinely by a fully additive process in a cost effective fashion. d. Implementation: The managers of the applicable project, other services, and other government agencies will be notified of the results of the project upon completion.

7. Economics:

a. This program will cost .200M in FY79 and .200M in FY80. There have been no known prior government R&D efforts in this area. Industry has supported all effort to date.

b. If adopted, an average PWB can be reduced in cost by approximately $10. A typical missile system will have a production potential of 500,000 boards; the use of fully additive printed wiring boards would save 5,000,000 with this number of boards.

c. This project will have no adverse effect on the environment.

Project No. R803444(MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803445(MIRADCOM) 2. 2597 3. Cost: .400M

4. Title: MM&T - Precision Machining of Optical Components

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: With increased emphasis within DOD on electro-optical and laser material programs, the optical manufacturing community, which is based primarily upon optical grinding and polishing techniques, cannot keep up with the demand, meet optical design requirements, meet production schedules, and stay within reasonable cost boundaries. Existing precision machining facilities are research and development devices and therefore do not lend themselves to production needs. (b) Solution: Timely adoption and transfer to industrial operations of precision machining processes, equipment and procedures that have been developed in R&D laboratories would reduce cost, manufacturing time, and procurement problems associated with optical components. This program will adopt and expand the technology developed by ERDA, DOD, and optical component vendors into a manufacturing capability. The major emphasis on this program will be to integrate both the well proven ERDA developed single point diamond machining capabilities and the developing interferometric aided and computer controlled technology into a manufacturing/production method for mirrors, lenses, and windows for laser, electro-optical, and missile system applications. (c) End Product: The project will include: (1) Definition of production processes for precision machining of Army electro-optical and laser materials. (2) Production device specifications for single point diamond precision machine. The machine developed under this program will be capable of manufacturing optical components with sizes ranging from a few millimeters (mm) up to 75 centimeters (cm) diameter and weights from a few grams up to approximately 90 kilograms. (d) Implementation: A joint venture between the government and a commercial vendor for development of the device and the on-line usage by the vendor of the developed hardware. Close coordination with Air Force, Navy, Lawrence Livermore Laboratories (LLL) and contractor communities will be conducted.

7. Economics: (a) Program cost: .300M-FY79, .400M-FY80, and .500M-FY81. (b) Prior R&D efforts by DOD has been estimated at $2.0M and by ERDA at $7-10M. (c) The economic analysis for this project is based on cost savings by the application of single point diamond machining for which quantitative costs and benefits could be obtained. It is anticipated that the final Tri-service total savings will be significantly greater than shown on EA. (d) This project will represent a uniform annual savings to the Army of $1,149,280.00; based upon supporting identified projects. (e) Execution of this project will not have a significant impact on the environment.

Project No. R803445(MIRADCOM)

PRODUCTION ENGINEERING MEASURES (PEM) REPORT
RCS CSGLD-1125(R1)

DUPLICATE

1. Project No. 180-7319 (AVRADCOM)   2. PA   3. COST: 550K

4. Title: MM&T - Production Methods for Digitally Addressable Multi-Legend Display Switch (MLD/S)

5. Facility/Contractor: US Army Aviation Research and Development Command, US Army Avionics R&D Activity. This project will be accomplished at a privately-owned electronic manufacturer having experience in fabricating militarized solid-state displays and switches. A contractor will be selected through competitive bidding. The work will be directed and supervised by USAAVRADA.

6. Summary:

(a) Problem - Although the need for an MLD/S has existed for some time, conventional projection (incandescent) lamps do not provide sufficient brightness to be readable in the aircraft environment. The Solid-State Multi-Legend Display/Switch has been demonstrated to be an important interface subsystem for a variety of avionics equipments. The experimental solid-state versions are expensive and difficult to manufacture because the mounting of commercially available electronic display circuitry, and switches must be made or assembled by hand in order to obtain proper ruggedness and operation of the structure.

(b) Solution - This project will establish the manufacturing techniques to properly mount, align, and fabricate solid-state displays, solid-state switches and solid-state drive circuitry into ruggedized, reliable, low cost, functional Multi-Legend Display/Switches for use in all Army aircraft at all illumination levels.

(c) End Products - The principal end product for this program will be a digitally addressable, solid-state multi-legend display switch which will be incorporated in control display units of all kind (in some, as the key input-output (I/O) display device; in others, as a key I/O element) and fault warning panels. They are especially applicable to digital systems.

(d) Implementation - Technology gained from this project will be disseminated during and following the development effort to industry and other Government agencies by distribution of all reports, presentations of briefings and through the auspices of the Tri-service MOA on Advanced Displays and Controls; and, if appropriate, at an industry-wide information dissemination meeting. For additional technical information contact Brad Gurman, US Army Avionics R&D Activity, Autovon 995-4201.

7. Economics: (a) An earlier 6.2 exploratory program was conducted to determine feasibility of a solid-state MLD/S. Three manufacturers provided different devices, all demonstrating feasibility. (b) There have been no preceding government-sponsored efforts on a prior program of this type (i.e., this project is a new project). (c) Funding for this program is $550,000. There will be no additional government costs to complement the project, since all implementation costs, including an industry-wide dissemination meeting, will be part of the project cost. (d) A preliminary economic analysis (Inclosure 2), including Tables 1 and 2, shows a cost savings of well over $10 million on the basis of 2,000 aircraft. Table 1 shows over 3,000 aircraft (in development, new and product improvement). The figures are conservative. It is contemplated that an equal number of MLD/S will be used in a variety of subsystems other than the two identified in the economic analysis, thus affecting even greater savings.

PROJECT #180-7319 (AVRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I) DATE: 1 June 78
3152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No. 5801003 2. PA 4250 3. Cost: $240K
4. Title: MMT, Low Cost Molded Packaging for Hybrid Electronics
5. Facility/Contractor: Harry Diamond Laboratories/Contractor to be selected
6. Summary:

a. Problem. Thick film hybrid circuitry is extensively utilized for artillery, mortar, and rocket fuzes, and is planned for use in small caliber (30mm to 40mm) rounds. All of these fuzes are high-quantity, low-cost devices that must survive an extremely high "g" environment. To achieve high "g" survivability, these hybrids are presently foam or epoxy potted, in place. These methods, however, do not provide adquate environmental protection; conventional hybrid packages, such as hermetic packages, are not used due to cost considerations.

b. Solution. Develop a process for high-volume, low cost, sealing and protection for hybrid thick film circuits and other fuze electronics. This project will apply molding techniques now used for making dual-in-line plastic packages to larger hybrid circuits. The process to be pursued is based upon bulk film protection of the substrate, followed by molding of the electronics, and, in specific cases, metal plating of the molded module to provide electrical shielding. This method will provide better environmental protection for the electronics, and, as by-products, a lower cost encapsulation due to shorter cure times, and less environmental problems due to the outgassing of foams during the curing cycle.

c. End Product. A process, and associated equipment for low-cost packaging of electronic circuits. The end product of this PEM project will be a technique for encapsulating the M734 amplifier by molding, and equipment for doing so on a continuous production basis. The process and equipment will be easily adaptable to other electronic designs.

d. Implementation. The process validated by this project will be included in applicable fuze procurements. The return on investment (ROI) from the result of this program will occur by the government's placing orders to procure production quantities of fuzes.

e. Technical point of contact for this project is J. Ansell, Autovon 290-2840.

7. Economics

a. (1) Related R&D Funding: FY77-$20K (DARCOM No.1L662616AH77); FY79-$15K(DARCOM No.1L662603AH18-14)
(2) Related PEM Funding: FY78-$50K (2763093)

b. Economic Analysis. A successful molded module package would result in a packaging savings of about $.20 per fuze. At any one time, one of the M734, M732, or XM587E2/724 fuzes will be in production at a conservative rate of 50,000 per month, yielding an annual savings of $120,000 per year per fuze type.

c. Environmental Effects. The environmental consequences of this project have been assessed and the approved EIA dated 1 May 1978 is attached. No significant environmental effect is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

Project No. 5801003(ARRCOM)

CM

EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 5801005 2. PA 4250 3. Cost: $315K
4. Title: MMT, Ceramic-Metal Substrates for Hybrid Electronics
5. Facility/Contractor: Harry Diamond Laboratories/Contractor to be selected
6. Summary:

a. Problem. Thick film hybrid circuitry is presently used extensively in artillery, mortar, and rocket fuzes, and is planned for small caliber (30mm to 40mm) rounds. All of these fuzes are high-quantity, low-cost devices that must survive an extremely high "g" environment. At the present time, all thick film hybrids are fabricated on a ceramic substrate, which is fragile at high-g shock levels, and must be adequately supported in order to survive. Utilization of procelain-coated steel substrates would eliminate survivability problems, but coating of the steel and fabrication of the electronics on the porcelain-steel has not been accomplished by production-oriented equipment at production rates.

b. Solution. Develop manufacturing methods and techniques for the production of thick film hybrid circuitry on metal-based substrates. This will include processes for applying an insulating layer on a preshaped metal substrate as well as the necessary processing of thick film materials to form electronic components.

c. End Product. A production process for manufacturing thick film hybrid electronics on a metal-based substrate. The process will be applicable to electronic fuze designs, as well as many non-fuze applications.

d. Implementation. The processes validated by this project will be included in applicable fuze procurements. The return on investment (ROI) from the result of this program will occur by the government's placing orders to procure production quantities of fuzes.

e. Technical point of contact for this project is J. Ansell, Autovon 290-2840.

7. Economics

a. Funding. Related R&D Funding: FY78-$40K (DARCOM No. 1L162120AH25-01);
FY79-$25K (DARCOM No. 1L662603AH18-14).

b. A successful metal-based substrate process would result in a savings of approximately $.25 per fuze. At any one time, one of the M732 or M734 fuzes will be in production at a conservative rate of 50,000 per month, yielding an annual savings of $150,000 per year per fuze type.

c. Environmental Effects. The environmental consequences of this project have been assessed and the approved EIA, dated 31 March 1978 is attached. No significant environmental impact is anticipated, nor is any environmental controversy expected to be associated with this action. An EIS is not required.

Project No. 5801005 (ARRCOM)

EXI T P-16 (Part I)
3152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5801345 (ARRCOM) 2. OP: 5397 3. Cost: $458

4. Title: MMT: Mfg Methods and Tech for the Biological Warning System

5. Facility/Contractor: ARRADCOM, Dover, NJ/Bendix Environmental Sciences Division, Towson, MD

6. Summary:

a. The problem: The Biological Detector and Warning System, composed of the XM2 Sampler, the XM19 Biological Alarm, associated Refill Kits, and Remote Alarms, is the only item which can provide biological agent detection capability to the Army. A full and complete manufacturing methods and technology project must be completed on the item to minimize problems during production. The Biological Detector and Warning System presents unique, difficult, and challenging production engineering problems. The two major sub-systems, XM19 Alarm and the XM2 Sampler are complex, scientific instruments of sophisticated design. They involve scientific disciplines of aerodynamics, chemistry, electronics, and systems analysis, and require competence in mechanical, chemical, structural, and electrical engineering, and unusual aspects will dominate the production engineering effort.

b. The solution: Perform engineering studies of problem areas identified by a PEP to insure production processes that will bring about more readily reproducible and less costly components. Of particular concern are the tape and drive assembly, liquid system, electronic logic, refill kits, vibrating pumps, and sequencing solenoids. The areas most critical to success of the Alarm System are 1) the tape transport system, 2) wash station assembly and 3) the particle impactor. The producibility aspects of these areas are being addressed by the FY78 MMT 5781345. Producibility and source identification for 1) the premix solutions, 2) adhesive tape, and 3) fluid pumps are the primary subjects of the FY79 MMT project. Studies concerning manufacturing methods and 1) collector-concentrator, 2) wash station, 3) impactor, 4) reaction cell, and 5) electronic circuitry initiated in FY79 will be completed in this FY80 MMT. Additionally, in FY80 producibility studies of the following items will be initiated and completed: 1) tubing and fittings, 2) sealing, 3) cable crimping, and 4) thermal electric cooler heater.

c. The end products of this project are: The total program will result in a fully documented and proven manufacturing method for use in production, and an item of assured reproducibility, with a minimum of sole source items that can be acquired on a broader base.

5801345

d. The implementation. All information gained will be included in the TDP, and made available to prospective producers.

e. The Environmental Impact Assessment: The environmental consequences of the project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 22 March 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,466 as follows: FY78-$480, FY79-$538, FY80-$458. Preceeding Government sponsored efforts for the biological alarm through FY78 for R&D are $24,160K.

b. An MMT project on items of such complex magnitude is a normal progression in the life cycle development.

DUPLICATE

E..
815.. P-16 (Part I)

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804141 (ARRCOM) 2. PA: 4250 3. Cost: $510

4. Title: MMT: Effect of Long Periods of Non Operating Environment on Electronically Controlled Fuzes

5. Facility/Contractor: ARRADCOM, Dover, NJ
Volunteer AAP, Chattanooga, TN
Joliet AAP, Joliet, IL
Lake City AAP, Kansas City, MO

6. Summary:

a. The problem: As part of the overall effort to improve and modernize the munitions production base, electronic control systems have been installed on various manufacturing lines. Many of these systems have been tested under production conditions and demonstrated smoother, and inherently safer operations of modernized facilities. Applications of modern control technology is anticipated in the future because of its potential benefits. However, current requirements for much ammunition are such that it has become necessary to place many present and future facilities in layaway. Since modernized munition plants would be expected to be available for mobilization for many years, enhanced design and procedural guidelines must be developed to assure readiness goals. Industrial experience or data on the degradation of industrial electronics while stored in a dormant mode is entirely inadequate. The proper technology must be developed if modernized munitions production facilities are to be capable of rapid reactivation.

b. The solution: A representative engineering system (or test bed) must be scrutinized to generate and correlate the data on the dormant degradation effects on the industrial electronic (includes electro-optic and related electro-mechanical) equipment used in modernized ammunition production. In lieu of obtaining equipment to generate the required engineering data, modern control systems at JAAP, VAAP and LCAAP will be used to achieve the above objective. Additional degradation data available from industry and other government sources, particularly related type Army plants, will be used to compliment experience gained at the prime sites. Suspect components when desirable, will be subjected to a thorough analysis in order to assess degradation and failure modes. This information will be used to generate guidelines for future system design to preclude from future systems, components and configurations deleterious to the readiness posture of these lines. In addition formalized procedural guidelines will be developed to handle this equipment in the standby state to assure the required readiness posture.

5804141

c. The end products of this project are: The end product of this program will be a set of designs and procedural guidelines defining the effects of long periods of non-operating environments on the class of industrial hardware used in electronic and electro-optic productive control systems in the plant modernization program. Products are: (1) technology base necessary to ensure that the manufacturing capability is not degraded by dormancy. (2) documentation of procedural guidelines to assure readiness of present and future modernization projects. (3) methodology to be applied during periods of non-operation to ensure restart and full production within the required time frame using prime lines on VAAP, JAAP and LCAAP as test beds to enhance early development of technology. (4) adjustment and/or verification of current spare parts provisioning.

d. The implementation: The results of this project will be to develop formalized procedural guidelines, based on the developed technology, for layaway, standby and reactivation of modernized plant electronic/computer controlled systems using the DDC continuous TNT lines and SCAMP lines as test vehicles for implementation.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 3 October 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics

a. Total cost of this program $1,490 as follows: FY78-$450, FY79-$530, FY80-$510.

b. No future costs are envisioned. Economic analysis are not primary considerations in this project. Rather, the effort will be undertaken in order to develop engineering data essential to the reliability and readiness of electronic productive control systems used in the production base. Use of existing army facilities as a test bed is highly desirable since it obviates purchase of extensive laboratory computer equipment to obtain the required data. While direct economic benefits are not attributable to this project, the technology developed may result in an equipment maintenance program which could potentially reduce placement costs, assure startup in adequate time and add a high degree of reliability for an efficient readiness posture period.

5804141

EXh _T P-16 (Part I)
8152

DUPLICATE

MC

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804182 (ARRCOM) 2. PA: 4250 3. Cost: $438

4. Title: MMT: Process Improvements & Auto Test for RAAM, GEMSS, GATOR

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801 Contractor to be selected

6. Summary:

a. The problem: Presently the electronics assembly for the XM75 and BLU91/B mines utilize several all-hand work operations which are slow and expensive. These are:

(1) Potting operation

(2) MCD assembly production

(3) MCD to Lens assembly and

(4) Wave soldering operation

Other problem areas are:

(5) Testing electronic components and sub systems

Currently some electronic components are not tested or else tested after being assembled with consequent re-work often required, and digital and magnetic test times are very long, causing production bottlenecks.

b. The solution:

(1) Redesign Potting fixtures to eliminate preliminary hand operations and automate sprue cutting.

(2) Automate Magnetic Coupling Device (MCD) Assembly

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(3) Automate MCD Assembly to Electronic Lens

(4) Improve process & design to prevent board warping and consequent loss of boards and reduce soldering rework which is presently a very expensive nand operation.

(5) Develop a high speed magnetometer tester, magnetometer core tester and diagnostic digital tester for electronic lens.

c. The end products of this project are:

(1) Prototype equipment to automate Potting Operation, MDC Assembly and MCD assembly to Electronic Lens

(2) Prototype equipment/process to improve wave soldering operation

(3) Magnetometer core tester

(4) High speed magnetometer tester

(5) Diagnostic digital tester

(6) TDP and a final report

d. The implementation: Acceptance testing and implementation will be at electronic lens contractors plant.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: Total project cost is estimated to be $602 (FY80-$438-FY81-$164)These costs include installation and implementation at the selected contractor facility.

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DUPLICATE

EXHIBIT P-16 (Part I)
8152

DATE: June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808010 (ARRCOM) 2. PW: 3297 3. Cost: $148

4. Title: MMT: Production of Acoustic Microwave Filters "CAM Related"

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Acoustic surface wave technology is well developed for the production of signal processing devices having frequencies in the megahertz and gigahertz range, but devices operating at the microwave frequencies of interest for fire control sensing systems are not available due to production problems associated with scaling the device to higher frequencies. The prime problem is the formation of complex metallic structures on suitable substrates with line spacing and tolerances measured in nanometers.

b. The solution: Adapt acoustic surface wave technology to production of components for optimum microwave/millimeter wave signal processing for the current generation of fire control sensing systems. A laboratory process is available which has been employed successfully to form complex metallic structures with the required dimensions. To form the complex planar metal patterns on suitable substrates, they are coated, masked, and then etched, all in a vacuum environment. After coating in a vacuum metallization station, they have a mask material applied on their surface and then an electron beam mask exposer is used to expose the filter pattern. Finally, ion etching is applied thru the mask to remove unwanted metallization.

c. The end products of this project are: The two year effort will yield a prototype production equipment to produce acoustic microwave filters supplemented by technical data resulting from the development of this equipment the first year. The second year will result in a pilot line operation of the equipment to verify operation and rates.

d. The implementation: The prototype system will be transferred to production of acoustic microwave filters in 1981. The filters will be incorporated in a number of advanced fire control instruments when available.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 March 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $381 as follows: FY79 - $233, FY80 - $148.

b. Economic Analysis: High frequency acoustic microwave filters can be produced "by hand" under laboratory conditions at the rate of 1 to 2 per month and an estimated cost of $3200 each. It is estimated that by using numerical control methods production rates of 30 units per day could be achieved at a unit cost of $47. For a projected annual requirement of 1000 units a cost savings of $3.2M results. The ROI is 178%; the S/I is 45.28.

c. The execution of this project will not have a significant impact on the quality of the environment.

6808010

EX .T P-16 (Part I)
8152

DUPLICATE

cm

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808054 (ARRCOM) 2. PW: 3297 3. Cost: $183

4. Title: MMT: Improve Manufacturing Techniques and Quality of Optical Scratch and Dig Standards for Fire Control Systems

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractors to be selected

6. Summary:

a. The problem: Although present Optical Scratch & Dig standards are a paragon of simplicity to the user, they are difficult and expensive to manufacture, calibrate, and maintain. The methods of manufacture and calibration require a high degree of skill and judgement. Existing manufacturing, quality control, and calibration operations are susceptible to great variances, and limited in accuracy, and are time consuming, fatiguing, and very expensive. The wood and glass boxes housing the standard discs are fragile and inflexible in control of their distribution to contractors, and vulnerable to environmental contamination.

b. The solution:

(1) Establish standard manufacturing methods and equipment for efficiently producing improved Optical Scratch and Dig Standards.

(2) Validate the improved manufacturing techniques and improved standards.

c. The end products of this project are: Documentation of the methods, equipment, and techniques to use by commercial optical houses to manufacture and calibrate Scratch and Dig Standards in an acceptable standardized manner. This will allow the government to avoid the cost and headaches now involved, yet allow interested parties an abundant supply of cheaper, better and more reliable standards traceable to the NBS.

6808054

d. The implementation: No further additional actions will be required after successful completion of this MMT program to obtain a return on investment. The results will be documented methods, techniques, equipment and designs that can be duplicated by the optics community at large.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 July 1977, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost for this project will be $461, as follows: FY80 - $183; FY81 - $278. Additional funding is expected from MTT 021-79 for automating the calibration techniques for the Scratch and Dig Standards. Determination of test conditions is already funded.

b. Quantifiable benefits will include inspection savings (due to more accessible standards which are currently in very short supply), lower procurement costs (due to cheaper manufacturing methods, cheaper and more reliable calibration methods, and cheaper construction), decreased maintenance costs (due to less fragile and more durable construction), lower calibration costs (due to construction which allows automated calibration), reduced litigation costs (due to less government - vendor disputes), and lower program costs.

c. The execution of this project will not have a significant impact on the quality of the environment.

EXH. .T P-16 (Part I)
P152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808080 (ARRCOM) 2. PW: 3297 3. Cost: $202

4. Title: MMT: High Speed Fabrication of Aspheric Optical Surfaces

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Optical components are a perennial requirement for fire control systems and the bulk of their cost lies in the figuring and polishing stage. The cost of production of optical surfaces can be reduced in two ways, by forming accurate surfaces at the generation stage and using the polishing stage only to make the surface smoother and also by reducing the number of elements in optical systems by using aspheric surfaces. One method for accomplishing both requirements is to use the tubular tool grinding process in a configuration in which the axes of the work and the cup are decentered, thus producing aspheric surfaces directly during the grinding process. Theoretical experimental study has been done at the University of Rochester's Institute of Optics. Aspheric surfaces have been generated by this procedure but to become applicable to production, further work must be done.

b. The solution: To make this method suitable for production, a two year effort will be initiated.

(1) In the first year, the following will be accomplished:

(a) The model of aspheric generation by tubular tool process will be tested over a wider range of radii of curvature, diameters and materials.

(b) Moire techniques will be adapted for testing rough surfaces.

(c) Aspheric single elements will be made rather than only one surface.

(d) A technical report covering results of the first year effort will be produced.

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(2) In the second year, the following must be accomplished:

(a) The model of aspheric generation will be interfaced to a lens design program with the family of possible aspheric surfaces included in the lens optimization program.

(b) A technical report covering the second year effort will be generated.

(c) The technical data from the theoretical and experimental studies will be used to generate a military specification for the use of this procedure by industry.

c. The end products of this project are:

(1) A technical report in the first year containing the information derived from the theoretical and experimental work verifying the model and its range of application.

(2) A technical report detailing the impact on the design phase and interfacing the aspheric generation model to optical design programs.

(3) A military specification prescribing its applicability to the manufacture of optical components for Fire Control Systems.

d. The implementation: A military specification standard will be published and circulated throughout ARRADCOM, ARRCOM and other DOD agencies. It will prescribe the use of this method in the production of fire control optical elements and detail the range of aspherical elements producible by this method and the inclusion of these capabilities in a lens optimization program.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: The total cost of this project will be $344 as follows: FY80-$202, FY81-$142.

a. SI ratio: 13.08

b. ROI:

c. EA: Based on projected requirement of 1000 items in new systems. Manpower requirements per item based on average requirements for eye pieces and objectives.

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EXHIBIT P-16 (Part I)
815

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808209 (ARRCOM) 2. PW: 3297 3. Cost: $193

4. Title: MMT: Pilot Production of Gradient Index Optics

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Gradient index optical elements offer a means of improving performance of Army optical systems while reducing cost of production. Gradient index optical systems have been produced in the laboratory. But a large scale production technique has not been established.

b. The solution: Techniques used to form gradient index optical elements on a laboratory scale will be further expanded to enable production of pilot lot quantities of optical blanks. Gradient index research and development has been conducted at the University of Rochester, Bausch & Lomb, Schott Optical and Kodak. Production of significant quantities of Gradient index optical blanks will be addressed by this effort.

(1) Develop a model of the ion exchange method of gradient index manufacture.

(2) Fabricate a series of lens systems.

(3) Test optical and material properties of lenses.

(4) Integrate material characteristics and optical performance requirements into a design for a pilot production line.

The second year effort will establish a pilot production facility at a contractor's site and provide production data for full use.

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c. The end products of this project are:

(1) A pilot gradient index of refraction lens production facility.

(2) Technical Report(s) detailing ion exchange manufacturing process, material properties and pilot production data.

d. The implementation: The pilot line will be transferred to production use in late 1981 and full disclosure made in the form of process sheets and a technical report. The need for a facilities project to expand production is forseen but there is insufficient data available to estimate cost.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $477 as follows: FY80 - $193, FY81 - $284. Previous research and Development was sponsored by industry and the National Science Foundation.

b. Results of Economic Analysis: Gradient index lens systems reduce the number of optical elements required for optical instruments by thirty percent compared to conventional anisotropic lens systems. For a projected annual requirement of 607 major fire control instruments per year, an annual cost savings of $1.17M results. The ROI is 172.503%; the savings/investment ratio is 16.991.

c. The execution of this request will not have an adverse affect on the quality of the environment or violate safety standards.

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AD-A067 887 ARMY INDUSTRIAL BASE ENGINEERING ACTIVITY ROCK ISLAND IL F/G 13/8
MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR FISCAL YEAR 19--ETC(U)
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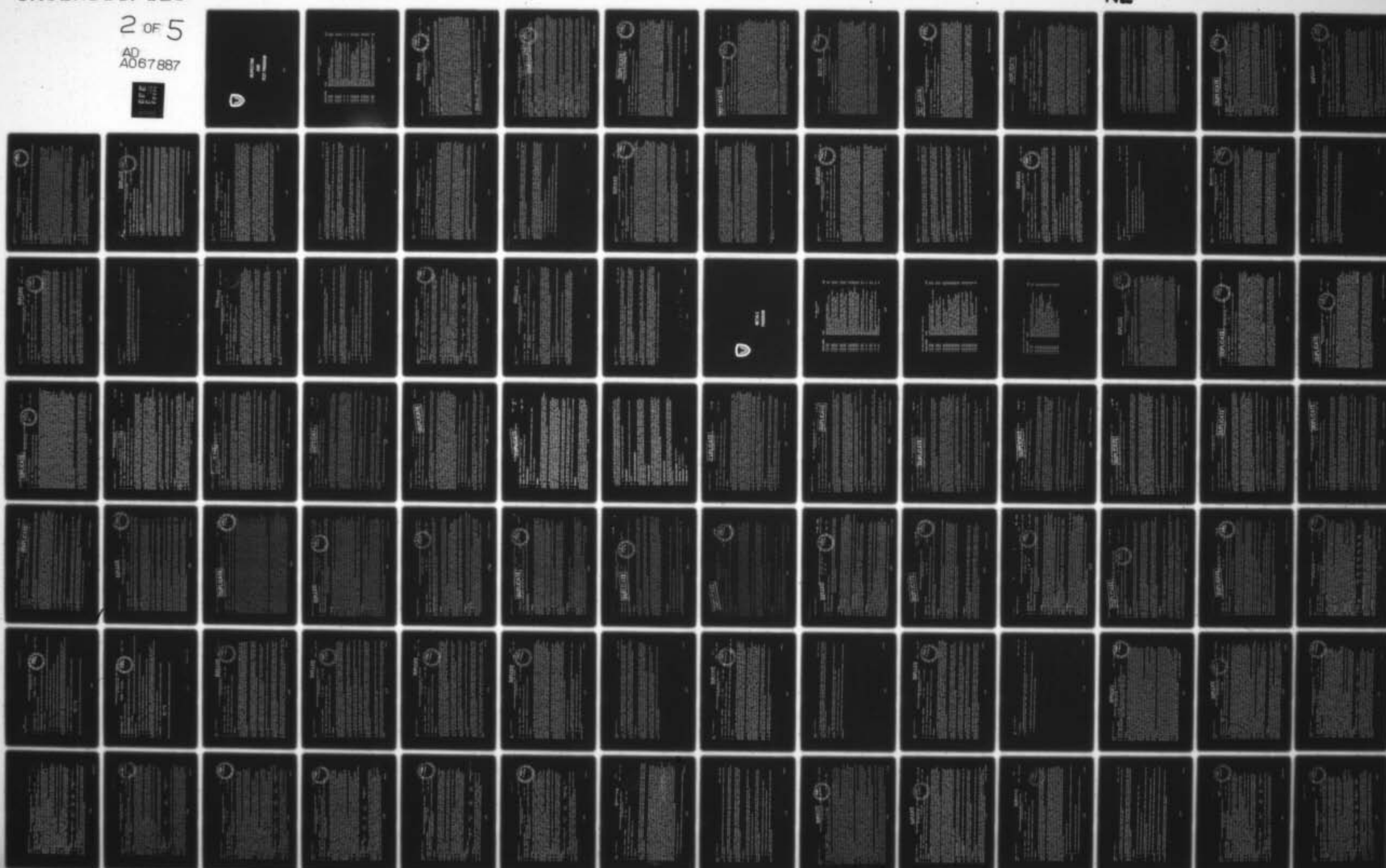

INSPECTION AND TEST PROGRAM

FY80 TEST AND INSPECTION PROJECTS
08/02/78

PROJECT NUMBER	TITLE	COST
F 80 3035	Built-in Test Evaluator	250
M 80 6350	MM&T Materials Testing Technology	4500
R 80 1028	Optimized Computer Thermal Analysis of Hybrids and P.W.B.	200
R 80 3241	Automate X-ray Readout and Provide 3D X-ray Capability	600
R 80 3244	Neutron Bombardment Non-Destructive Testing	300
R 80 3376	Testing of Electro-Optical Components and Subsystems	375
T 80 6028	Production Quality Control by Automated Inspection Equipment	293
1 80 7119	Non-Destructive Evaluation Techniques for Composite Structures	400
1 80 7175	Automated Blade Contour Inspection (Computer Aided Inspect)	275
1 80 7345	Inprocess Control of Resin Matrix Cure	250
3 80 3115	Engineering for Metrology and Calibration	747
5 80 0900	Automated Multiple Filter Life Tester	250
5 80 0901	XM29 Protective Mask Automated Test Equipment	1691
5 80 3961	Impr (3-D) Vib Accept Testing for Art Fuzes and S/A Mechanisms	605
5 80 4131	Shell Holographic Inspection and Examination Line Device	550
5 80 4133	Automated Inspect for Defects in the M55 Det	599
5 80 4266	Mfg, IHSP and Test Equipment for Magnetic Power Supply	341
5 80 4274	Recov and Regen of Propl Mfg Solvents by Auto Control	250
5 80 4276	Production Optical Inspection System 155mm Knurl, (POISK)	152
6 80 8048	Impr Insp Tech for Ingots and Preforms for Rotary Forging	112
6 80 8054	Optical Scratch and Dig Standards for Fire Control	183

DUPLICATE

RECEIVED 5 MAY 1978

EXHIBIT P-16 (Part I) DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. F803035 (CORADCOM) 2. PA 5297 3. Cost: $250K

4. Title: MM&T for Built-in Test Evaluator

5. Facility/Contractor: This project will be performed at a privately owned manufacturing facility selected through competitive negotiated bidding with technically qualified sources and will be supervised by CORADCOM.

6. Summary: (a) Problem - The use of Built-in Test (BIT) is being stressed by all three services for use during operators' and organizational maintenance to reduce cost and the need for skilled personnel in the field. Future Army electronic materiel will contain BIT within subsystems, modules, and even to the LSI/VLSI chip level. This BIT capability could be used to reduce production testing costs. However, prior to utilizing this BIT capability as part of the production test cycle, it will be necessary to certify the adequacy of the BIT capability to meet or exceed production test performance criteria. (b) Solution - Computer-aided test design (CATD) techniques will be used to evaluate the BIT capability within subsystems, modules, and/or LSI/VLSI chip level. The results of the CATD analysis will provide information about the adequacy of the BIT capability to detect: (1) faults within the BIT circuitry itself; (2) catastrophic faults within the total fault population of the system; (3) component variations which lead to fault tolerance build-up of system signal levels and/or timing; and (4) sensitive variations in calibrated system performance parameters. This information will provide a numerical basis for establishing the adequacy of the BIT capability to perform production testing. To accomplish the aims of this project, a multiyear program will be required. The first phase work will study non-complex BIT capabilities and their adaptability to CATD. The future years' work will be concerned with an increase in BIT complexity and will expand the techniques data base. Funds in the amount of $250,000 will be expended in FY-80 and $500,000 in FY-82, for a total of $750,000. (c) End Product - The end product of this effort will include a firmware/software test system consisting of a computer program for evaluating the BIT, a minicomputer, and an input/output terminal. (d) Implementation - A protype line demonstration to industry will be accomplished at the conclusion of the project.

7. Economics: (a) I. R&D Expenditures - FY-78: $159K (R&D Task No. 1L1 62779 AH 62), FY-79: $200K (Planned).
II. PEM Expenditure: FY-82: $500K (Planned).
(b) Results of the economic analysis indicate savings of $10.5 million - $18.2 million.
(c) Execution of this project will not have a significant impact on the quality of the environment.

EXHIBIT P-16 (Part I) DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. M806350 (AMMRC) 2. PA 5397 3. Cost: $4,500 (T)

4. Title: MM&T Materials Testing Technology (MTT)

5. Facility/Contractor: Work to be performed almost exclusively by the following facilities: AMMRC, APG, AVRADCOM, ERADCOM, HDL, MERADCOM, MIRADCOM, NARADCOM, ARRADCOM, ARRCOM, TARADCOM and other facilities as the program develops

6. Summary: a. Problem: To respond to DARCOM inspection needs by determining materials testing requirements in mechanical, chemical and nondestructive testing and providing on a priority basis new and/or advanced testing methods, procedures, and equipment to facilitate evaluation of the materiel or material procured or maintained by DARCOM. As outlined in AMCR 702-14 this effort supports the majority of DARCOM items in production or scheduled for production where a mechanical, chemical, or nondestructive test is or should be a requirement for acceptance, surveillance, or maintenance.

b. Solution: This effort will provide new and/or advanced mechanical, chemical, or nondestructive test methods, procedures or prototype equipment for the inspection and/or process control of items in production or scheduled for production. The program also entails furnishing technical assistance in application of methods and techniques in solving materials problems in connection with currently procured or design items. This is a continuing quality assurance measures project which does not include production tooling and/or the establishment and operation of pilot production lines. In all cases, the R&D effort has been finalized and has proven the method or technique feasible for inspection applications.

c. End Products: End products the Government will receive from this project are as follows: (1) Prototype Models, (2) Technical Reports, (3) Test Data, (4) Quality Control Data and Inspection Aids Including Production Test Data, (5) Specifications, and (6) Standards.

d. Implementation: In some cases no additional actions will be required after successful completion of this effort to obtain a return on investment. In others, a follow-on MM&T effort is required; e.g., the current MTT program in support of the 155mm projectile melt pour modernization program where the MTT Program will provide and evaluate the engineering model of an automated NDT inspection system in advance of constructing the production system scheduled for FY78.

7. Economics: a. The MTT Program was initiated in FY63. The FY78 effort, funded at a level of $4.5 million, is 100% obligated. Each task within the total effort, excepting contracted efforts, is scheduled for completion within 12 months of receipt of funding.

b. Whereas savings in the amount of $75 to $100 million have been directly attributable to MTT Program efforts, the availability of inspection methods, where none had existed previously, contribute to savings which are far in excess of this amount. The MTT Program does not lend itself to the economic analysis format.

c. Performance of this project will have no adverse effect on the environment or violate safety standards.

Project No. M806350 (AMMRC)

EXHIBIT P-16 (PART I)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

Date: 1 Jul 78

1. Project No. R801028 (MIRADCOM) 2. 5297 3. Cost: $.2M

4. Title: MM&T - Optimized Computer Thermal Analysis of Hybrids and P.W.B.

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: The trend in military electronics is for highly dense packaging techniques with an inherent increase in power dissipation and need for heat removal. This thermal stress of semiconductor and other components is directly related to component value drift and more importantly - reliability. There are a variety of computer programs available for use in thermal analysis of hybrids. Most of the very thorough programs, such as CINDA, are cumbersome and not well adapted for use with hybrid thermal analysis. Some of the others have questionable accuracy. "Burn-in" tests require high thermal stress for relatively short periods of time; however, there is a maximum temperature for semiconductor components that should not be exceeded. Hence, there is a great need for an optimized accurate, efficient, standardized program that maximizes the programmer's effectiveness. (b) Solution: Adapt and optimize the most effective program available for use in the manufacturing environment for proper selection of heat transfer techniques and materials. (c) End Products: This project will result in (1) a deliverable, optimized hybrid thermal analysis program in a widely used higher-order language; (2) technical reports on detailed theory of operation, test results of accuracy and program results; (3) a users manual that will allow ease of use. (d) Implementation: Project Managers will be notified of the availability of this software. Technical presentations and technical reports will be sent to appropriate technical societies.

7. Economics: This program will cost $.2M in FY80 Cost savings as a result of completion of this project will be primarily due to a reduction of test time and the expected increase in product reliability. The military uses several million hybrids and P.W.B.s a year and it is estimated that for hybrids alone a 20 percent savings can be achieved.

The execution of this project will not have a significant effect on the environment.

Project No. R801028 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

RECEIVED 5 JUL 1978

1. Project No. R803241 (MIRADCOM) 2. 2597 3. Cost: .600M

4. Title: MM&T Automate X-Ray Readout and Provide 3D X-Ray Capability

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: X-ray inspection is a universal nondestructive test tool in material and parts testing. Among failure mechanisms detected are solder balls, broken/displaced leads, lifted pads. In structures, defective welds, improperly assembled devices, and fatigue cracks are among defects found. X-ray inspection is invaluable in the inspection of mechanical and electro mechanical devices, X-ray is flexible, and has tremendous growth potential. A relative newcomer to nondestructive testing, neutron radiation testing, is also growing rapidly in importance. Most structural metals are highly transparent to neutrons, and organic materials extremely opaque. Fluxes and lubricants are easily found by N-radiography, even through heavy sections of metal. These contaminants are the most common causes of failure and erratic performance in component parts, sealed electromechanical devices, and one-shot devices. (b) Solution: X-ray and neutron radiation are easily viewed by television systems. The standard system is 525 line (broadcast) resolution: This is inadequate for nondestructive testing; but an upgraded T.V. system with a resolution of 1050 lines is feasible and can be assembled from largely commercial parts. Such systems, having four times the area resolution of the broadcast format, are little used because they require four times the input radiation required for 525 line scan. A new scintillator overcomes this problem. This device, obtainable on special order, is a fiberoptic scintillator. The fiberoptic scintillator is many times as efficient at converting input radiation into light as presently used devices, with ample resolution to support a thousand-line scan. This will allow the new 1000 line television to image in much lower input X-ray than any X-ray television system today; and will allow neutron imaging with a generator instead of an atomic pile. (c) The End Product: The end product will be a fully documented X-ray and neutron radiographic television system, convertible within minutes to either input; with a nominal 1000 line resolution, optimized for inspection. The system will have a direct viewing capability, and state-of-the-art image processing with both digital and analog methods. Provision will be made for permanent photographic recording. (d) Implementation: After successful completion of the project, the project is expected to be self-implementing, and to be manufactured commercially, with a potential of several hundred systems, of varied sophistication, to be produced per year.

7. Economics: This project will cost .600M in FY80 and .552 FY81. Economic analysis is based on two systems over a ten year service life, and a requirement for inspecting 50,000 missile systems per year. Conventional radiographic inspection would exceed $100 each, or $50,000,000. X-ray and neutron radiography with direct viewing coupled with computer assistance will reduce cost by two-thirds, or $33,330,000. Execution of this project will not have a significant impact on the environment.

Project No. R803241 (MIRADCOM)

EXHIBIT P-16 (PART I)

DUPLICATE

RECEIVED 1 MAY 1978 DATE: 1 May 78

PRODUCT ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Priority No. 26 Project No. R803244(MIRADCOM) 2. 5297 3. Cost: $.3M

4. Title: MM&T Neutron Bombardment Nondestructive Testing

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: Flux and lubricants are the most frequent contaminants found in component parts, sealed electromechanical devices, and sealed one-shot devices. These organic contaminants tend to cause erratic operation and failures. Organics are not found by X-ray inspection, due to the low X-ray scatter of their elements. Since organics have a large percentage of hydrogen and carbon in their composition, their thermal neutron scattering is high; and they are easily found through large thicknesses of most metals by neutron radiography. (b) Solution: An effective, low-cost per item neutron radiographic television system can be used for inspecting such parts for organic contaminants at a rate of better than one a minute, or 1000 in an 8-hour day. This can be done by using a sub-critical automic pile to safely produce a well-colimated thermal neutron flux at above a 10^8 neutrons/cm^2/sec, which will allow direct viewing with a very short (10-15 second) integrating period to produce a single stored output image carrying details requiring a nominal 1000 line television at maximum resolution. The system would test inorganic components for organic contamination. (c) End Product: (1) Equipment for production neutron radiographic non-destructive inspections of sealed electrical, pyrotechnical, and mechanical missile components at a rate of 1,000 per 8-hour day, 20,000 per month per system. (2) System specifications, plans, manuals, and other requirements for a fully functional system. (3) A technical report will be prepared to fully document the system and program results. (d) Implementation: After successful completion of this project, action will be taken to disseminate results to project managers, other commands and services. Project Engineer - Robert Brown, Autovon 746-3995.

7. Economics: NASA conducted R&D efforts in neutron radiographic viewing systems through Zenith Radio Corporation under contract NAS8-30070. No other efforts are known. This project will cost $.3M in FY80 and $.3M in FY81. The economic analysis for this project is based on the testing requirements for Army systems utilizing gyros, accelerometers, squibs and similar devices. The potential savings is $3,287K Execution of this project will not have a significant impact on the environment.

Project No. R803244(MIRADCOM)

EXHIBIT P-16 (PART I) DATE: 1 JUL 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803376(MIRADCOM) 2. 2597 3. Cost: .375M

4. Title: MM&T - Testing of Electro-Optical Components and Subsystems

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Manufacturing technology necessary for production of electro-optical system is very limited. Measurement techniques for electro-optical components are limited to static testing and/or substitution testing in the end product, requiring rework of the electro-optical system. No correlation exists between component specification and electro-optical system performance. This results in over specification of components and undue system costs. (b) Solution: Many Army systems use electro-optical components of the same general type: lenses, filters, coatings, laser rods, mirrors and domes. Because specific system components are purchased only in small quantities, economy of production could be achieved by establishing testing methods or techniques to validate existing specifications or replace them with new specifications which impact system performance rather than individual components. (c) End Products: End products of this project will include: (1) manufacturing data for elctro-optical component processing, (2) technical report repsenting testing methods, specifications for components and system performance, (3) demonstration of testing techniques and equipment for government and industry representatives. (d) Implementation: After successful completion of this project action will be taken to disseminate results to project managers, other government agencies and commands.

7. Economics: (a) This project will cost .375M for FY78 and .375M for FY80. Prior government sponsored R&D effots on improving electro-optical testing techniques and equipment was limited to components used in laser locator designator systems. (b) Based on electro-optical system requirements for STINGER, CHAPARRAL, HELLFIRE GLLD, and ALLD and an estimated savings of 750K per year could be expected. (c) Execution of this project will not have a significant impact on the environment.

PROJECT NO. R803376(MIRADCOM)

DUPLICATE

1 JUL 1978

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. T806028 (TARADCOM)   2. PA 3197   3. Cost $293,000

4. Title: MM&T (Phase I) (CAM) Production Quality Control by Automated Inspection Equipment

5. Facility/Contractor: Contractor, DRCPM-FVS, and USATARADCOM, Assessment and Research Division, Warren, Michigan

6. Summary:

a. The increased complexity of combat vehicle engine, automotive electrical and turret electrical control systems has reduced the Government confidence of production quality, which can be ascertained through manual/visual acceptance tests and test track performance checkout. The increased complexity and sophistication of combat vehicle technology has also increased the skill level requirements of inspectors to identify production hardware performance deficiencies. The Project Manager of the Fighting Vehicle System (FVS) will build in engine, automotive electrical, and turret electrical test harnesses to be used in conjunction with field test equipment to fault isolate for performance problems. Other combat vehicle managers are considering the same action. These harnesses can and should be used for production quality performance inspection.

b. This program will apply the knowledge gained on PEM project 4765055. During project 4765055 commercial automotive diagnostic equipment was modified and adapted to particular military vehicles, the M809, M113A1, M551, M109, M561 and M60A1/A2 and RISE. Since a combat vehicle, FVS, will now be manufactured with test harnesses, the knowledge gained on PEM project 4765055 can be applied to production inspection. The equipment will be compatable for quality performance inspection of the other combat vehicles listed above once these vehicles are manufactured with test harnesses.

c. Two commercial automotive diagnostic units, Autosense, will be adapted for quality performance inspection of the FVS in particular and combat vehicles in general. An evaluation report on automation of inspection records will be made.

d. Hardware application for production inspection will be accomplished at the production contractor's facility in FY 81 and the hardware will be available for other combat vehicle productions when application conditions become favorable.

e. The execution of this project will have no significant impact on the quality of the environment.

f. The Project Engineer on this program is Robert J. Watts, Assessment and Research Division, USATARADCOM (Autv 273-2841/2849).

7. Economics:

a. No R&D funds have been used for this project. The PEM project funding will be $293,000 for FY 80 and $247,000 for FY 81.

b. The economic analysis on the program shows that there are quantitative benefits which can be realized by using commercial automated diagnostic equipment for production quality performance inspection. The quantitative benefits result from the use of the diagnostic equipment to diagnose production deficiencies, reduce the time to make "end of line" production inspection and the Final Inspection Record (FIR) and reduce time to compile production quality reports. A gross savings to investment ratio for the program would be between 2.63 to 1 and 1.79 to 1 (discounted between 1.83 to 1 and 1.29 to 1), depending on whether Contractor or Government personnel would use the inspection equipment.

In addition to the quantitative benefits, certain qualitative benefits would be realized through implementation of this program. The Government confidence of production product quality and performance capability would be increased. Skill and training requirements for production inspectors would be reduced. Automated inspection equipment, which could be applied to other vehicle productions, would also become available.

c. This project will not violate any safety standards.

DUPLICATE

EXHIBIT P-16 (Part I) 1 JUL 1978

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: 1807119 (AVSCOM) 2. PA: 1497 3. Cost: $400

4. Title: MM&T Non-Destructive Evaluation Techniques for Composite Structures

5. Facility/Contractor: U.S. Army Aviation Systems Command, St. Louis, MO: U.S. Army Materials and Mechanics Research Center, Watertown, MA; and private contractor(s) to be determined.

6. Summary:

a. This project will provide a manufacturing handbook for non-destructive in-process inspection of composite structures.

b. The R&D in support of this program has been funded by the Army, Air Force, Navy, and NASA and by private industry. The Army's Materials Testing Technology (MTT) Program has established many of the production test and inspection techniques that are used to inspect composite materials.

c. A large number of non-destructive testing (NDT) techniques have been developed and are being used with composite structures with widely varying configurations. NDT methods such as ultrasonic, transmission and reflection infrared, acoustic emission, acoustic holography, optical holography, and neutron and X-radiography have been used. Various manufacturing defects such as debonds, gaps, overlaps, cracks, wrinkle and fiber breakage can be detected. The structures examined range in complexity from skins, flat panels and curved panels through rotor blades.

This project will initially use the composite rotor blade to develop data for the project. Then, once the data is obtained, the information obtained would be applied to other composite structures. Depending on the configuration and stress levels in the structure, various criteria will be established for acceptance or rejection based on number, type and size of the measured defects. The proposed Handbook will list the types of structures inspected, the type of inspection methods used, the defects tested for, and the acceptance/rejection criteria used.

Point of contact for this project is Mr. M. A. Kornitzky, AV 955-3524.

7. Economics:

a. This project is a four-year MM&T effort totaling $1,362,000 (FY77-$475k: FY78-$87K; FY79-$400k; FY80-$400K).

b. The use of this Handbook by designers and manufacturing personnel will lead to improved inspection techniques. This will result in more accurate inspection and a corresponding net savings in excess of $1,800,000.

c. The execution of this project will not have a significant effect upon the quality of the environment (See Inclosure 2, Environmental Assessment Statement).

Project No.: 1807119

DUPLICATE

EXHIBIT P-16 (Part I) Date: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD - 165 (R1)

1. Project No: 1807175 (AVRADCOM) 2. PA: 1497 3. Cost: $275

4. Title: MM&T - Automated Blade Contour Inspection/Computer-Aided Inspection

5. Facility/Contractor: U.S. Army Aviation Research and Development Command, St. Louis, Mo and private contractor(s) to be determined.

6. Summary:

a. It is necessary to measure the contour of certain helicopter surfaces with a high degree of accuracy. These measurements are required to be made on surfaces with widths of up to 42 inches and are made of a large number of points. If hand methods are used for these measurements, the effort is time consuming and susceptible to errors. If a conventional system were developed using contact or proximity probes, the accuracy of the measurement would depend upon the stability of the mechanical structure which serves as the reference.

b. This project will develop a computer aided, noncontacting optical gauging system to automatically inspect contours of spars and airfoils of helicopter rotor blades. The R & D in support of this program has been funded by private industry. A breadboard optical system, under contract No. DAAK 50-78-C-0008, has been developed using MTT funds.

c. Technology gained from this project will be disseminated to industry and other government agencies by reports and briefings.

7. Economics:

a. This project is the first year of a two-year MM&T effort totaling $550,000 (FY80, $275,000; FY81, $275,000).

b. R & D efforts preceding this project have been accomplished by a number of private contractors.

c. This new method will increase inspection accuracy, reduce time required for inspection by 1/3 and provide for reproducible contour inspections.

EXHIBIT P-16 (Part 1) Date: 1 RECEIVED 7 AUG 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 1807345 (AVRADCOM) 2. PA: 1497 3. Cost: $250

4. Title: In Process Control of Resin Matrix Cure

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertown, MA, and private contractor(s) to be selected.

6. Summary:

a. Problem: Conventional control of the cure stage during composite hardware manufacturing is attained through manual or automatic control of the autoclave/press temperature as a function of time. The particular time-temperature-pressure cycle employed is fixed as a result of previous processing and mechanical testing of coupon specimens. This method does not consider the chemical state of the resin during the cure which is dependent on: (1) prepreg room temperature out time. (2) variation in heatup rates due to thermal mass of tooling and multipart autoclave batch processing and, (3) batch to batch prepreg stoichiometry.

b. Solution: In process control techniques capable of monitoring the resin flow/cure behavior is needed to insure production of components having consistently high quality. In addition, the in process control technique must provide output signals which can be employed in a computer-controlled feedback loop for the control of autoclave/press conditions so that all parts are maintained within an acceptable cure envelope. Northrup IRAD efforts have shown that ion graphing is capable of providing the necessary information to a computer controlled cure system and this effort will develop the required software for the closed loop computer control of the autoclave/press process and demonstrate its applicability in curing composite helicopter structures.

c. End Products: The end products of this project will include the necessary software for closed loop computer control of composite curing methods and prototype tooling for process demonstration.

d. Implementation: The results of this project will be disseminated to the helicopter industry and other government agencies by means of technical reports and briefings. For additional information, point of contact is Mr. Stanley Tozlowski, AMMRC, AV: 955-3513.

7. Economics:

a. This project is a two year effort totalling $425,000 (FY80 - $250K; FY81-$175K).

b. R&D effort is being performed by Northrop Corporation under IRAD funds during FY78 and FY79.

c. The use of in-process control methods for composite materials will result in reduced costs of quality control, productivity, and part rejection.

d. The execution of this project will not adversely effect the quality of the environment (See Inclosure 1, Environmental Assessment Statement).

Project No: 1807345

DUPLICATE

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EXHIBIT P-16 (Part I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE: July 1978

RCS CSGLD 1125(R1)

1. Project No: 3803115 (MIRCOM) 2. PA: 5397 3. COST: $747

4. Title: MM&T - Engineering for Metrology and Calibration

5. Facility/Contractor: MIRCOM/Contractor(s) to be selected

6. Summary: The problem is that measurement science (metrology) must be continually advanced in relevant technology areas to keep pace with Army programs in support of research, development, production, operation and maintenance activities.

The solution is to investigate, adapt and test technologically advanced systems and components required to support the accuracy specifications of Army TMDE. Modern equipment for electronic, electro-mechanical, physical and electro-optical measurement parameters is involved.

The end products of this project are advanced technology measurement systems and components for the Army Calibration System. These measurement standards provide the basis for compatibility and integrity of Army measurement systems, and serve as the link to National Standards maintained and disseminated by the National Bureau of Standards.

A return on investment is obtained when new support requirements are satisfied using measurement technology developed as a part of this project. It is necessary to have proper calibration equipment available on a current basis to provide both measurement parameter and accuracy coverage required for an Army-wide support mission. Benefits from this project will be realized each year as new equipment is added to the program to cover current requirements.

7. Economics: The need for this project is continuous. Prior year project funding has been FY 75-$430, FY 76-$577, FY 7T-$147, FY 77-$594, FY 78-$681, FY 79-$700. Planned followon year requests are FY 81-$787, FY 82-$830, FY 83-$875. Additional government costs include OPA funds to purchase required quantities of items for use in the calibration program.

The economic analysis is based on non-monetary benefits. Measurement science (metrology) must be advanced in relevant technology areas to keep pace with Army programs in support of research, development, production, operation and maintenance activities.

The performance of this project will not have an adverse effect on the environment or violate safety standards.

Project No. 3803115 (MIRCOM)

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5800900 (ARRCOM) 2. OP: 5397 3. Cost: $250

4. Title: MMT: Automated Multiple Filter Life Tester

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Current filter life test equipment has a low test rate based on the limitation of only one (GB testing on the Q216) and two (CK testing on the Q95) test filters at a time. Because of this low test rate capacity and an increasing volume of testing, GB and CK filter life test schedules are increasingly difficult to maintain by the ARRADCOM, PAD, CSD, Chemical Test Branch. An increased test load is anticipated based on canister evaluation requirements for the XM29 Protective Mask development and subsequent production and surveillance testing. Establishment and control of the test conditions for each test is extremely labor intensive. The chemical agent test stream with which the filter is challenged must be controlled to the specified concentration, temperature, relative humidity and test flow. In addition, each tester has its own agent supply and the logistical requirements of agent handling is extensive.

b. The solution: Manpower needs can be reduced by developing a multiple test chamber tester which will permit four items to be tested simultaneously. The optimum number of test items has been estimated to be four based on operating efficiency and size limitations placed on the equipment by the laboratory hoods of building E5100. A high capacity agent test stream control module will prepare a filter challenge stream which meets specification criteria. Commercial instrumentation will continuously monitor the challenge concentration and relative humidity. The test module for the system will have four test chambers piped from a manifold in the control module. The challenge flow will draw through each of the four test filters by regulated vacuum source. The flow to each test filter will be controlled and measured by a commercial rotameter and valve assembly. The effluent from each test filter will be monitored for the "break concentration" with a commercial chemical detector.

The tester will be designed with extensive automatic controls allowing one operator to perform four tests simultaneously. Substantial savings will result from decreased manpower requirements and a reduced number of testers.

c. The end products of this project are: The final end products of this MMT project will be gas life test equipment and associated TDP documentation sufficient to perform four simultaneous GB and CK life tests of individual protection filters with multiple chambered equipment.

d. The implementation: After successful completion of the MMT project, no additional action is required to obtain a return on investment.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. No prior government sponsored efforts have been undertaken to improve the efficiency of individual filter life testing through the use of a multiple chambered tester. The total cost of this project will be $250, as follows: FY80 - $250.

b. Based on the economic analysis (Program Evaluation Studies Format A-1) this project is the cost effective alternative to test individual protective filters for gas life.

c. The gas life test equipment will be designed to insure that no adverse effects on the environment occur and no safety standards are violated.

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5800901 (ARRCOM) 2. OP: 5397 3. Cost: $1,691

4. Title: MMT: Automated Test Equipment for XM29 Protective Mask

5. Facility/Contractor: ARRADCOM, Dover, NJ/Beckman Instruments, Inc., Anaheim, CA 92806

6. Summary:

a. The Problem: During the Engineering Development contract for the XM29 Protective Mask, the contractor will develop prototype testers for mask inspection. These testers will include inspection for optical quality, coating presence and leakage. The optical requirements alone cover several qualities including haze, optical power and distortion, and light transmission. Since some of the optical requirements can be combined in one tester, the exact number of testers is not know at present; however, three or four individual prototype testers are anticipated. Although the prototype testers will be suitable for initial low production rates, the anticipated rate of regular production of 3500 masks per day would require several of each tester. This would add greatly to the mask cost, both in initial costs (multiple testers) and continued costs (multiple operators).

b. The Solution: An automatic test station will be designed. The mask will be mounted on a fixture and rotated through multiple test stations where it will be automatically tested for optical quality; haze,scratches and digs, percent transmission, and color; and leakage. Maximum utilization will be made of automatic data processing for real time rejection/acceptance. Although the qualities to be tested are not new to the optical/photographic trade, the application of those qualities to the XM29 Mask presents a number of unique problems. Among the factors causing these problems are the size and shape of the viewing area, the flexibility and relative softness of the optical material, and the high production rate for the mask.

c. The end products of this project are: The final end products of the MMT project will be high-rate automated production test equipment for the XM29 Protective Mask and the associated test equipment technical data package.

d. The implementation: At the conclusion of this project the test equipment TDP will be integrated into what will then be the M29 Protective Mask.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,691K as follows: FY80 - $1,691. No prior R&D funds have been expended on automated test equipment for the XM29 Mask. R&D funds are being expended for prototype individual testers and much of the information obtained during the individual tester development will be utilized on this project. However, due to the problem areas discussed in paragraph 6b, combining the testers in one automated table will required modification of the individual stations in addition to the extensive work required to combine and automate those individual stations.

b. The benefits resulting from this project will be:

(1) A savings of $929,000 per year for each year of production.

(2) A total discounted savings of $2,250,000 based on a five year production.

c. This project will have no adverse effect on the environment and will not violate any safety standards.

DUPLICATE

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EXHIBIT P-16 (Part I)
8152

Date: 1 June 1978

RECEIVED 14 JUN 1978

Production Engineering Measures (PEM) Project RCS-CSCRD-165 (R1)

1. Project No.: 5803961 IMPL
2. PA 4250 STNG
3. Cost: $605 ART

4. Title: MM&T - Improved (3-D) Vibration Acceptance Testing for M732 and XM587/724 Artillery Fuzes and S&A Mechanisms

5. Facility/Contractor: (1) HDL, Br. 850; (2) Contractor (TBD)

6. Summary: Lot acceptance requirements for the M732 and XM587/724 artillery proximity fuzes and their safety and arming (S&A) mechanisms mandates the exposure of 275,000 S&A's and 17,500 assembled fuzes to 6 hrs/item transportation vibration (TV) tests per MIL-STD-331 method 119 II. The current method is acutely deficient in that it (a) is costly and time-consuming and (b) rarely exposes the test item to the true service environments. TV tests are conducted unidirectionally requiring up to three (3) duplicate (sequential) tests to account for all test axes. As a result of this duplicate effort the aggregate TV testing cost for the specified fuzes/S&A's based on current component acceptance requirements is estimated at 2.340 million dollars over a 5 year production span. Unidirectional testing is furthermore unrealistic in that most fuze materiel in the field is known to experience simultaneous, rather than sequential, three-dimensional (3-D) vibrations. The problem is further compounded by the unavoidable transverse shaker vibrations which are uncontrolled in 1-D testing and lead to the execution of other than the specified tests (which therefore vary from test site to test site). As a result: (1) lot acceptance TV testing becomes excessive and, potentially failure-prone fuze materiel may be delivered to stockpile because of an unrealistic inspection procedure.

Use of computerized 3-D vibration/shock testing as an acceptance tool will solve these technical and economic test deficiencies. Overall test time will be reduced by as much as 67% as a result of simultaneous rather than sequential testing. An improvement of this magnitude can potentially reduce the total testing cost by approximately 1.6 million dollars. Technically, 3-D testing will also produce field-coupled (related) vibration modes that cannot be induced, and therefore tested for, in 1-D testing. Furthermore, 3-D testing will assure a realistic acceptance procedure by employing a computer controller to subject fuzes/components to field environments as acquired during product development (or analyzed from existing data banks).

Experience establised by this facility in implementing unidirectional digital computer control techniques to affect sinusoidal/random vibration testing (HDL-TR-1665, 1975) indicates this to be a low risk project. Computerized test control equipment, already funded by DARCOM/PBS-PSER program during FY77/8 to modernized and upgrade PBS vibration/shock testing, will be used to implement basic 3-D testing.

Project No. 5803961 (ARRCOM)

The end item of this project will be an operational 3-D test system capable of simultaneously vibrating a 100 lbs., fuze payload to 75g in the longitudinal direction and 40g in the two transverse axes within the 5-3000 Hz range; amplitude and spectral-equalization control will be maintained at ± 2dB and ± 6dB respectively. These capabilities will satisfy all known MIL-STD-TV requirements as well as worst case environments anticipated in service. 3-D testing specifications will be included in the technical data package to beneift the specified fuze programs at time of procurement. A description of the test system and associated hardware is presented in section 12.0 (addendum - detailed cost breakdown), section 15.0 (technical description), and figure 1 (proposed 3-D shock/vibration test system configuration).

The environmental consequences of this project (3961) have been assessed and the approved (installation) EIA, dated April 77 is available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIA is not required.

7. Economics. Use of 3-D test procedures as an inspection tool for lot acceptance/transportation vibration testing can potentially reduce projected aggregate cost ($2.34 million dollars) by as much as 67% (to appx. $0.8 million) over a 5 year period. Investment cost of this PEM project ($760K) (*) will be amortized within 5.0 years of operations. Additional substantial savings on the order of magnitude specified herein are expected beyond the initial 5 year economic period as fuze production is expected to continue well into the future but with no additional investment in test equipment necessary (the useful life of the 3-D test system is estimated to be at least 10 years). Additional benefits will be realized by using the 3-D test system to support first article acceptance testing, engineering control samples testing, and stockpile reliability and failure investigation testing. Utilization of 3-D testing in the procurement of other Army materiel will establish another major cost-effective benefit.

(*) $255.0K in FY79 and $505.0K in FY80 - uninflated dollars; This PEM project is the remaining portion of a 2 year MMT effort.

EXHIBIT P-16 (Part I)
8152

DUPLICATE

DB

Date: 13 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804131 (ARRCOM) 2. PA: 4250 3. Cost: $550

4. Title: MMT: Shell Holographic Inspection and Examination Line Device (SHIELD)

5. Facility/Contractor: ARRADCOM, Dover, NJ; Non-Government facilities to be selected

6. Summary:

a. The problem: The Army's Production Base Modernization Program for ammunition plants includes requirements for high rate inspection of metal part artillery projectiles. Presently, there is no completely automatic nondestructive inspection system which is testing shells at 100% production rates, other than magnetic particle, which is basically an enhanced visual inspection with its inherent liabilities. Metal part defects within artillery shells are considered major potential causes of premature functioning. Although standard NDT technology (i.e., X-Ray, ultrasonics, mag particle, dye penetrant, eddy current) has been available for the last thirty years, it has proven to be unsuccessful in solving this problem. With the exception of Radiography, all other techniques approach the inspection problem from a microscopic point of view. Radiography will inspect the entire shell at once. However, the ability to detect cracks is extremely sensitive to orientation; therefore, many films must be made of one shell. The result is that an efficient, reliable, and cost effective means of inspecting all large caliber projectiles has eluded the efforts of the modernization program.

b. The solution: It is proposed that a Production Prototype Double Exposure Holographic inspection system system be developed that will automatically inspect the entire 155MM M483A1 metal part projectile. This prototype system will be based on existing state-of-the-art technology developed within Government facilities and industrial laboratories over the previous ten to fifteen years. Recently published reports indicate that the principles of Holography and related hardware have been developed to the extent that a fully automatic testing system is feasible, thus taking full advantage of this technique. A Materials Testing Technology Program (MTT 7X-133) will establish correlation data on shell pressurization, actual crack size, and the resulting holographic pattern response for the M483A1 projectile. The most significant advantages that Double Exposure Holography have over other NDT methods are: 1) this is a macroscopic test, that is, the entire shell will be inspected at one time, 2) the limiting factor for inspection speed will be the material handling system, 3) Evidence of cracks will be proportional to the strength lost as a result of that crack, this factor will

minimize inaccurate (false) rejects due to surface marks, 4) as a result of utilizing this technique, it will not be necessary to spin the sehll, rotate it any manner, to scan the shell, immerse it in some fluid, or spray it with a solution, and 5) a permanent record may be kept of the inspection for future reference with minimal cost.

c. The end product of this project are: A completely automated detection system for metal part cracks within the M483A1 projectile, at an inspection rate capable of providing 100% on-line inspection. All detection, acceptance and rejection functions will be performed automatically without the need for human interpretation. Once this system is in use, it will serve as a model for future inspection systems of other caliber artillery and/or mortar munitions.

d. The implementation: Final installation of this system will be at MSAAP. Installation will be funded by facilities project #5813142.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the EIA, dated 1 April 1978 are available. No significant environmental impact is anticipated, nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost for this project is $1257. Project funding by fiscal year: FY80 - 550K; FY81 - 544K; FY82 - 163K.

b. Quantifiable benefits will include inspection savings due to simplified testing and elimination of false reject indications. Non-quantifiable benefits include increase dynamic NDT technology.

c. The execution of this project will not have a significant impact on the quality of the environment.

EXHIBIT P-16 (Part I)
815

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804133 (ARRCOM) 2. PA: 4250 3. Cost: $599

4. Title: Automated Inspect for Defects in the M55 Det

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801; Contractor to be selected.

6. Summary:

a. The problem: With the advent of ICMs, the mobilization requirement for M55 Detonators has risen to 131,000,000 per month to be produced on largely nonexistent equipment. Currently, inspections are performed manually on a sample of the production. Ongoing projects (4000 and 4457) will automate and increase the production rate for M55 Detonators to as high as 200 parts/minute/machine - also requiring fully automated 100% inspection.

b. The solution: This project is a product assurance measure to conceive, design, fabricate, and evaluate techniques and equipment for inspecting for noncritical defects in the M55 Detonator at rates comparable to the new high-speed detonator loaders

c. The end products of this project are:

(1) An automated detonator inspection prototype.

(2) A TDP for ordering replicate prototypes

d. The implementation: The results of the project will be implemented by incorporation into the end item technical data package, and will be of a direct benefit to the modernization of Detonator (M55) facilities.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assured and the approved results of the Environmental Impact Assessment (EIA), dated 31 March 1978 are available. No significant environmental impact is anticipated nor is any environmental controversey expected to be associated with this action. An EIS is not required.

EXhIBIT P-16 (Part I)
8152

DATE: 1 June 1978

7. Economics:

a. The total project will be $1513K with funding required as follows: FY 79 - $283K, FY80 - $599K, FY81 - $631K.

b. The benefits resulting from this project will be:

(1) A savings of $363K per year and a ROI of 21.071%

(2) Reduction in direct personnel exposure to explosives thereby improving safety.

(3) Improved product uniformity and reliability.

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5804133

EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804266 (ARRCOM) 2. PA: 4250 3. Cost: $341

4. Title: MMT: Manufacturing, Inspection and Test Equipment f/Magnetic Power Supply

5. Facility/Contractor: ARRADCOM, Dover, NJ/Bulova

6. Summary:

a. The problem: Piezoelectric power supplies used in HEAT ammunition have been observed to leave undesirable voltage generation impressed on the electrical circuiting of the round due to shock vibrations resulting during flight. While not conclusively proven to cause premature functioning it is considered significantly hazardous to warrant elimination of this undesireable effect.

b. The solution: PIP IA 87533 for the improvement of the M456A1 HEAT cartridge includes the safety and cost saving modification of moving power supply from the nose of the round to inside the PIBD fuze housing and changing it to a magnetic pulse generating type power supply which is unaffected by the aforementioned shock vibrations. Additionally, the reference PIP results in a validated per round cost saving of $5.39. Initiating in FY79 and culminating in 4Q81, the PIP program requires a two year MMT program to acquire the manufacturing, inspection and testing methods and technology to produce the magnetic power supply. This type of power supply which has found use in other munitions such as guided missiles (larger and withstanding and responding to relatively lower gravitational forces) has never been produced in the physical size and quantities required for Artillery, Tank or Mortar Ammunition. The methods and technology obtained will be for full or partial automation as quantities and cost dictate. The MMT will be applicable to future generation ammunition such as the PIBD fuze for the XM815 HEAT-MP-T 105mm cartridge and the PIBD fuze for the 120mm XM1 Tank HEAT-MP-T cartridge.

c. The end products of this project are: The GOCO hardware and equipment acquired under this project will provide for automated or semi-automated production of Magnetic Power supplies at a cycle rate of 10 seconds. Additional end products will be accumulated; manufacturing, inspection, and testing data and a final report. This item can be used for other products, some of which are yet to be designed. Its size is favorable for easy adaptation and its Modular Construction can offer it as an "off-the shelf" item for a multitude of applications. Ease in manufacturing resulting from this effort will increase its potential for future use.

5804266

d. The implementation: The results of this project will be implemented in the production line for the product improved PIBD fuze resulting from PIP 1A87533.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 13 March 1978. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,042 as follows: FY80 - $341, FY81 - $701

b. The benefit resulting from this project will be: A safer, more reliable and economical type power source will be made available for PIBD fuzes and an automated or semi-automated method will be provided to produce them.

E: IT P-16 (Part I)
8152

DUPLICATE

JP

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804274 (ARRCOM) 2. PA: 4250 3. Cost: $250

4. Title: MMT: Recov & Regen of Propl Mfg Solvents by Auto Contrl

5. Facility/Contractor: ARRADCOM, Dover, NJ/Hercules, Inc, Radford AAP, Radford VA

6. Summary:

a. The problem: The activated charcoal solvent recovery units at Radford Army Ammo Plant operate on a timed cycle, open loop, controlled basis. The time cycles were established by empirical calculations. However, the solvents content of the air passed through the charcoal beds fluctuates widely from time to time. As a result, operation of the solvent recovery units on a time sequence basis rather than an activated charcoal load capacity basis results in inefficient recovery of solvent and unnecessary use of thermal energy.

b. The solution: Maximum efficiency of the activated charcoal solvent recovery operation and thermal energy use can be achieved by using solvent detection instrumentation to determine when the activated charcoal is saturated on the adsorption cycle and when the activated charcoal is free of solvent on the regeneration cycle. Using a solvent detection system to determine the duration of each cycle would result in the most efficient solvent recovery system possible.

c. The end products of this project are: The end products will be a Technical Report, Test Data, and Design Criteria for conversion of a solvent recovery house to automated operation both at RAAP and other GOCO plants with similar recovery systems.

d. The implementation: Subsequent action to the successful completion of this project will be the purchase and installation of similar controls on the other two solvent recovery facilities at RAAP under PS & ER funding.

There will be a pilot ...

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

5804274

DATE: 1 June 1978

7. Economics:

a. This will be a one year program requiring $25C for design, acquisition, installation and evaluation of a system installed in the original control are to operate one solvent recovery facility control system.

b. On the basis of current production rates for single-base propellants, the annual savings would amount to approximately $216/yr.

c. This project will not have an adverse affect on the quality of the environment.

5804274

EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804276 (ARRCOM) 2. PA: 4250 3. Cost: $152

4. Title: MMT: Production Optical Insp System 155MM Knurl, (POISK)

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801
Non-Government facilities to be selected.

6. Summary:

a. The problem: The design of the present 155MM rocket assisted projectile (RAP) family provides for the pressence of a fine diamond knurl between the rocket motor body and warhead base. This interface prevents relative motion between the two components during flight. If this motion is not restricted variation in moment of inertia will cause unstable flight characteristics. Inadequate knurling discovered during post mortem investigations of short rounds has been identified as a significant contributing facture in the occurrence of these short rounds. It is necessary that the proper knurl (within dimensional requirements) be on both components. To insure adequacy of the knurl an automatic inspection testing technique is required .

Presently a Material Testing Technology (MTT), FY78 Task No ARRADCOM 01-78 for a prototype optical inspection system or interface Knurl on the 155MM M549 RAP Projectiles has been approved. This prototype will be a sophisticated test system requiring additional effort to fully integrate the system into a modern production line. The prototype will result in a Semi-Automated Insp System.

b. The solution: It is expected that the prototype (MTT) above will be available in Aug 79. It is proposed that this prototype (Semi-Automatic Insp Sys), be redesigned to incorporate and provide fail-safe techniques and automatic segregation of rejected parts (i.e., set up procedures and methods, data retrieval, etc.) The system can then be fully automatic and be used in a modernized production line. Project # 3004A (FY80), M549 RAP MPTS.

c. The end products of this project are:

(1) A TDP for a completely automated optical inspection system for the interface Knurl on the 155MM RAP. This system design will serve as the basis for future inspection systems for other caliber artillery munitions.

(2) A Production Optical Inspection System for the Interface Knurl (155MM RAP) for incorporation into a modernized production line at the reliability required.

(3) Final Technical Report

d. The implementation: It is proposed that this MMT will support Project No 3004A (FY80) M549 RAP MPTS (Proposed in the Five Year Procurement Plan).

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any enironmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. This is a one year FY80 project for a total cost of $152.

b. Non-quantifiable benefits from this project are:

(1) The probability of eliminating a poor interface which has shown to cause unstable flight characteristics.

(2) The ability to inspect the Knurl without requiring interpretation and with reliability in the accept/reject decision. The present status Quo Alternative is a visual inspection, (human eye).

c. The execution of this project will not have a significant impact on the quality of the environment.

Exhibit P-16 (Part I)
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 June 1978

1. Project Number: 6808048 (ARRCOM) 2. PA: 3297 3. COST: $112

4. Title: MM&T: Improved Inspection Techniques for Ingots and Preforms for Rotary Forging

5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y., Benet Weapons Lab.

6. Summary:

a. The Problem. The current technique for inspection of ingots and preforms for rotary forging is time consuming and prone to error. Each ingot or preform must satisfy an internal soundness requirement. Ultrasonic inspection is necessary. If done by hand, it is prone to error and takes a long time.

b. The Solution. Automatic ultrasonic techniques will be developed to allow more rapid and more accurate inspection. The manufacturing technique for inspecting a preform as it feeds into the Rotary Forge Integrated Line will be developed.

c. The End Products. The end product of the program will be an automatic production inspection technique necessary to rapidly inspect incoming ingots.

d. The Implementation. The inspection techniques will be incorporated into existing production procedures and will be utilized by Operations to determine the suitability of incoming preforms.

e. Environmental Impact Statement. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

	Preceding R&D	Prior FY	FY80	Implementation
	$0	$0	$112.0	$0

b. Benefits:

(1) Quantifiable: The development of a suitable automatic inspection technique should reduce inspection times by approximately 20-25%, resulting in a corresponding savings in this aspect of inspection.

(2) Non-Quantifiable: The developed technique will also be capable of being utilized by the preform producers, thereby enabling them to relate production practice to quality and soundness. This should result in an overall increase in the quality of incoming material.

EX. .T P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808054 (ARRCOM) 2. PW: 3297 3. Cost: $183

4. Title: MMT: Improve Manufacturing Techniques and Quality of Optical Scratch and Dig Standards for Fire Control Systems

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractors to be selected

6. Summary:

a. The problem: Although present Optical Scratch & Dig standards are a paragon of simplicity to the user, they are difficult and expensive to manufacture, calibrate, and maintain. The methods of manufacture and calibration require a high degree of skill and judgement. Existing manufacturing, quality control, and calibration operations are susceptible to great variances, and limited in accuracy, and are time consuming, fatiguing, and very expensive. The wood and glass boxes housing the standard discs are fragile and inflexible in control of their distribution to contractors, and vulnerable to environmental contamination.

b. The solution:

(1) Establish standard manufacturing methods and equipment for efficiently producing improved Optical Scratch and Dig Standards.

(2) Validate the improved manufacturing techniques and improved standards.

c. The end products of this project are: Documentation of the methods, equipment, and techniques to use by commercial optical houses to manufacture and calibrate Scratch and Dig Standards in an acceptable standardized manner. This will allow the government to avoid the cost and headaches now involved, yet allow interested parties an abundant supply of cheaper, better and more reliable standards traceable to the NBS.

6808054

d. The implementation: No further additional actions will be required after successful completion of this MMT program to obtain a return on investment. The results will be documented methods, techniques, equipment and designs that can be duplicated by the optics community at large.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 July 1977, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost for this project will be $461, as follows: FY80 - $183; FY81 - $278. Additional funding is expected from MTT 021-79 for automating the calibration techniques for the Scratch and Dig Standards. Determination of test conditions is already funded.

b. Quantifiable benefits will include inspection savings (due to more accessible standards which are currently in very short supply), lower procurement costs (due to cheaper manufacturing methods, cheaper and more reliable calibration methods, and cheaper construction), decreased maintenance costs (due to less fragile and more durable construction), lower calibration costs (due to construction which allows automated calibration), reduced litigation costs (due to less government - vendor disputes), and lower program costs.

c. The execution of this project will not have a significant impact on the quality of the environment.

METALS PROGRAM

FY80 METALS PROJECTS
08/02/78

PROJECT NUMBER	TITLE	COST
F 80 3005	Graphical Part Programming Evaluation	95
R 80 1018	Improved Manufacturing Processes for Dry Tuned Accelerometers (CAM)	380
R 80 1031	Eliminate Gold on Printed Wiring Board Edge Contacts	230
R 80 3294	Production Processes for Rotary Roll Forming	200
T 80 4586	Improved Large Armor Steel Casting (Phase 2)	900
T 80 5002	Manufacturing Methods for Fabricating Torsion Bar Springs from Steel	275
T 80 5006	Production of Lightweight Steel Cast Track Shoes	150
T 80 5007	Advanced Technology Brake Lining Materials (Phase II)	190
T 80 5019	Storage Battery, Low Maintenance - Phase III	290
T 80 5054	Laser Surface Hardened Combat Vehicle Components (Phase 2)	175
T 80 5068	New Anti-corrosive Materials and Techniques (Phase 1)	200
T 80 5080	Fabrication Methods for Aluminum Transmission Cases	150
T 80 5081	Fabrication of Friction Rings and Reaction Plates	210
T 80 5082	Flexible Machining System, Pilot Line for TCV Components	880
T 80 5088	High Power Electron Beam Welding in Air (Phase 2)	250
T 80 5090	Improved and Cost Effective Machining Technology (Phase 2)	290
T 80 5091	Heavy Aluminum Plate Fabrication (Phase 1)	420
1 80 7052	Ultrasonically-assisted Cold Forming of Titanium Nose Caps	250
1 80 7155	Cost Effective Manufacturing Methods for Helicopter Gears	375
1 80 7197	Fabrication of Integral Rotors by Joining	250
1 80 7199	Surface Hardening of Gears, Bearings, and Seals by Lasers	250
1 80 7240	Machining Methods for ESR 4340 Steel for Helicopter Application	235
1 80 7241	Hot Isostatic Pressed Titanium	524

FY80 METALS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
1 80 7248	Closed Loop Machining T700 Mid Frame	500
1 80 7285	Cast Titanium Compressor Impellers	250
1 80 7286	High Quality Superalloy Powder Production for Turbine Components	130
1 80 7291	Titanium Powder Metal Compressor Impellar	240
1 80 7298	High Temperature Vacuum Carburizing	150
1 80 8116	Erosion Resistant Coatings for Titanium Alloy Compressors	160
5 80 1001	Pilot Line for Fuze Fluidic Power Supplies	250
5 80 1903	Die Cast Tailcone for BLU-96/B	1187
5 80 1904	One Piece Skin for BLU-96/B	439
5 80 4184	Form Sabot Segments to Net Shape on APFSDS Ammo	425
5 80 4187	Forming Boom of Heat Ammo by Upset Forging	325
5 80 4188	Forming Tail Fin for APFSDS Projectile	200
5 80 4189	High Fragmentation Steel Production Process	1490
5 80 4190	Molding Rear Seal, 120mm Frg, APFSDS, Projectile	384
5 80 6738	Ultra-high Speed Metal Removal, Artillery Shell	350
6 80 3901	Manufacture of Fluidic Amplifiers by Cold Forming (Phase 2)	343
6 80 7605	Chemically Bonded Sand for Close Tolerance Casting	130
6 80 7730	Manufacture of Split Ring Breech Seals	148
6 80 7917	Application of Bore Broaching to Mid-caliber Cannon	181
6 80 7920	Conservation of Critical Materials for Gun Tubes	233
6 80 7925	Bore Evacuator Boring	110
6 80 7926	Hot Isostatic Pressing of Large Ordnance Components	214
6 80 7927	Generation of Base Machining Surfaces	85
6 80 7933	Central Coolant Systems	65
6 80 7940	Synergistic Platings with Infused Lubricants	120

FY80 METALS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
6 80 7948	Establish Cutting Fluid Control System	158
6 80 7949	Application of Group Technology to RIA Manufacturing (CAM Related)	155
6 80 8001	Rapid Flow Plating of Small Caliber Gun Tubes	130
6 80 8024	High Speed Abrasive Belt Grinding	321
6 80 8026	Application of Synthetic Quenchants to Gun Tubes	141
6 80 8035	Coating Tube Support Sleeves with Bearing Materials	140
6 80 8043	Improved Machining Procedures for Dovetails	160
6 80 8045	Self-implementation Prototype	140
6 80 8047	Pass Thru Steady Rests for Tube Turning	90
6 80 8050	Recycling Spent Gun Tubes by ESR Melting	168
6 80 8105	Establish Rough Thread Blanks, 8-inch M201 Bushing	87
6 80 8106	Large Caliber Powder Chamber Boring	58
6 80 8107	Creep Feed Crush Form Grinding	344
6 80 8208	Material Handling	112
6 80 8341	Hollow Cylinder Cut Off Machine	68
6 80 8342	Keyway Milling Machine	239

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 May 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. F803005 (CORADCOM) 2. PA 5297 3. Cost: $95[illegible]

4. Title: (MM&T) Graphical Part Programming Evaluation

5. Facility/Contractor: This project will be performed in-house by CAD-E/CAM Division, Technical Support Activity (official designation within CORADCOM not known at this time), and by competitively selected contractors.

6. Summary - (a) Problem - The state-of-the-art of Numerical Part Programming Languages is a dynamically changing environment. The introduction of Computer Aided Design (CAD) systems and the retention of computerized data bases has a profound impact on the methods by which this data is transferred to end item production. The traditional method for the transfer of design to production was for a numerical control part programmer to transfer data from an engineering drawing to a numerical control machining tape by use of a numerical control part programming language. This method typically required several iterations and, depending on the complexity of the part, could take from hours to weeks to program. (b) Solution - Some CAD systems have built-in computer programs to perform the numerical control part programming function at some level of proficiency. This project is to define the systems that have programming capabilities and to evaluate the degree of effectiveness by which they produce the numerical control part program and the efficiency of the program produced. (c) End Product - This project will produce an evaluation matrix of CAD systems, programming capabilities, control tape efficiencies, and part class versus system selection criteria. With this information DoD installations and agencies will have an effective source of data to select the appropriate system for their use. (d) Implementation - The results of this project will be disseminated to Government and industry by coordination with the Manufacturing Technology Advisor Group. Technical point of contact: Melvyn S. Kosmin, Autovon 995-4778/4940.

7. Economics: A formal economic analysis was not submitted since precise cost savings are not determinable. However, DoD spends over 16 Billion dollars per year on numerical control and conventional fabrication processes. If an estimated 5% of this capital spent is used on numerical control programming, this would amount to 80 million dollars per year. Assuming a 10 percent savings is realized in NC programming processes as a result of CAD system evolution then 8 million dollars annually will be saved. The precise savings are estimated but the magnitude of the potential savings are realistic and realizable. The execution of this project will not have a significant impact on the quality of the environment.

Project No. F803005(CORADCOM)

EXHIBIT P-16 (PART I) DUPLICATE DATE: 1 July 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R2)

1. Project No. R801018 (MIRADCOM) 2. 2597 3. Cost: 380

4. Title: MM&T - Improved Manufacturing Processes for Dry Tuned Accelerometers (CAM)

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: There is a need to establish manufacturing methods necessary to increase yield and reduce cost of dry tuned accelerometers for use on the Strapdown Inertial Guidance Demonstration (SIG-D) and Long Range Guided Missile (LRGM) Programs. The present method used to manufacture the dry flexure supports for the acceleration sensitive element consists of several distinct machining operations on a lathe. The mechanical setup and running time for each operation is excessive. The risk of making a catastropic error during a final machining operation is always present. Checkout is not automated. (b) Solution: The use of electrical machining processes such as electrical discharge machine (EDM), electrical discharge wire cutting (EDWC), electrochemical machining (ECM), and electrochemical grinding (ECG) will allow automated machining of the complex dry flexure supports based on a programmed process. A manufacturing optimization effort will be performed by conducting cost (and yield) tradeoffs versus electrical impulse rate, gap between tool and workpiece, type of dielectric fluid, and cutting tool shape. The process will be totally automated to allow use of low skilled operators to run more than one machine at a time. A more novel approach will be to adjust the tooling to cut more than one flexure support at a time. (c) End Products: End products of the project will include hardware - accelerometers flexure supports, assembled accelerometers; and software - manufacturing data, computer program process. (d) Implementation: A pilot - production line will be established and contractor - operated for dry tuned accelerometers.

7. Economics: (a) This project will cost $380K for FY80. Prior R&D Funds - $225K, DA Project No.'s 1L162302A214 and 1L362303A214. (b) The savings realized by the completion and enactment of this project would be $1,800,000 over a five year period. In large quantities without MM&T, the cost of the dry tuned accelerometer is $1400. With MM&T, the cost can be reduced to $1100. (c) Execution of this project will not have a significant impact on the environment.

Project No. R801018 (MIRADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

DATE: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM)
RCS CSGLD 1125 (R1)

RECEIVED 5 JUL 1978

1. Project No. R801031 (MIRADCOM) 2. 2597 3. Cost: .230M

4. Title: MM&T - Eliminate Gold on Printed Wiring Board Edge Contacts

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: Most commercial and many military printed wiring boards use on-piece board-edge connectors. Increasing numbers of such boards are used in military systems. Gold over nickle is standard for high reliability circuits; gold adds nearly a dollar to the cost of each connector; since to the intrisic cost of gold is added a labor-intensive plating process for card-edge contacts. (b) Solution: (1) Plate connectors with a less expensive metal or alloy. Palladium, tin-nickle and nickle, either with or without tin or indium as a lubricant will be evaluated as a direct replacement for gold; having equal reliability. (2) Using the developed metal system, investigate the application of high speed "pulse plating" to the edgeborad contacts. Design and optimize tooling to be used for repetative plating of card edge contacts with the minimum of labor, thus achieving improved quality at lower costs. (c) End Products: The end products of this project will be (1) a base metal system to replace gold on card edge contacts, (2) a high-speed automated process for plating card edge contacts with the selected metal system; with special equipment, tooling and instrumentation requirements; a full set of reports, manuals, drawings and all documentation to allow ease of duplication of equipment and results. (d) Implementation: After successful completion of this project action will be taken to disseminate results to project managers, other commands, and to various suppliers.

7. Economics: This project combines proposed MM&T Project No. 3265, "Eliminate Gold on Printed Wiring Boards Edge Contacts" and proposed MM&T Project No. 1031, "High Reliability, High Speed Plating of Card Edge Contacts" This project will cost $.230M in FY80, and $.240M in FY81. The following estimate is based on a known usage of more than 8,000,000 boards per year. The cost of plating edge card contacts is more than $1.00 per board. A cost saving of 80% can be expected; the savings to be expected is $6,400,000 per year over an expected ten year service life. This does not include the added potential of savings if the gold universally used on pins and sockets in cable connectors were replaced.

EXHIBIT P-16 (PART I) DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM PROJECTS)
RCS CSGLD 1125 (RI)

Date: 1 Jul 78

1. Project No. R803294 (MIRADCOM)

3. Cost: .200M

4. Title: MM&T - Production Processes for Rotary Roll Forming

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: Problem - The purpose of this project is to establish manufacturing processes for rotary roll forming for producing low cost solid propellant rocket motor components. In spite of past efforts to reduce motor production costs, rockets have difficulty competing with tube artillery in such applications as the area fire saturation mission and with balloons for the delivery of meteorological payloads. In such applications, rocket motors must be designed and manufactured at the absolute minimum cost consistent with the propulsion requirements. Recent efforts have led to the concept of adapting the rocket motor design to utilize tube mill products such as API line pipe(used for gas distribution mains). The principle reason commercial tubing has not been exploited for rocket motor components in the past is the problem encountered in incorporating nozzle and head closures. Mechanically joining or welding a conventional closure to a commercial tube is generally more expensive than an integral case/closure manufacturing method such as deep drawing or shear spinning currently used in the aerospace industry. Solution - In order to obtain the cost benefits of commercial tubing, a low cost method of incorporating the closures must be developed. One highly promising method for producing integral nozzles with tubular products is the rotary roll forming technique. Roll forming is a manufacturing operating whereby a set of external rolls apply a compressive face to the tube to form the integral nozzle contour. The project would optimize the fabrication procedures for roll forming integral nozzles in API linepipe or equivalent tubular products. This project would provide production engineering data essential to current and future motor component requirements. End Items - End products of this project will include: (1) Manufacturing data which will consist of data for processing specification, material requirements, equipment requirements, processing data and NDT control data. (2) Technical reports on detailed manufacturing processes, test procedures and program results. (3) Components for rocket motor firing demonstrations. Implementation - After successful completion of this project, action will be required to disseminate results to project managers, other commands and other services. Special emphasis will be placed on applicability to those items scheduled for production.

7. Economics: This Agency has conducted a feasibility demonstration for a 6 5/8 inch diameter solid propellant motor utilizing rolling forming technology with standard line pipe. This R&D effort was conducted under DA Project Nr. 1M362303A214 and totaled 150K. This project will cost .200M for FY80 and .175M for FY81. The economic analysis for this project is based on the structural requirement for an area fire saturation mission of 50,000 units per year. This would represent a uniform annual savings of $5,650,000. per year over a six year period. Execution of this project will not have a significant impact on the environment.

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165-(RI)

1 JUL 1978

DUPLICATE

1. Project No. T804586 (TARADCOM) 2. Code: 3197 3. Cost: 900K

4. Title: MM&T: Improved Large Armor Steel Castings (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/ Contractor to be selected

6. Summary: Project Officer - Harry Spiro, DRDTA-RCKA, AV: 273-1389

a. Cast armor steel (Specification MIL-A11356) provides a level of ballistic performance 8-15% below steel armor plate (Specification MIL-A-12560). This performance can be greatly improved through special techniques for increasing steel soundness. Such techniques have been demonstrated on a laboratory basis but have not been evaluated for scale up in the manufacture of large complex structures. (greater than 2-inches thick)

b. A major improvement in armor castings can be made through advanced solidification techniques (i.e., embedded chilling materials, miscellaneous inoculants, special conductivity sands, etc). This can provide a density of cast armor more closely matching rolled armor. Specific cast products (i.e., steel mill rolls) have been successfully upgraded through special techniques and similar improvement has been indicated for armor castings using these procedures. Phase I work of this proposed project is expected to determine parameters for successfully applying these new solidification techniques to heavy cast armor sections. Mechanical, metallurgical and ballistic property analyses to be performed to assess level of material quality improvement. Phase II work will fabricate full scale components and validate the process.

c. The end products will be technical procedures (reports) and prototype hardware. This program will supply a turret front section ballistically superior to present cast armor and approximately equivalent to wrought armor plate.

d. Action for a new specification or a change to the existing cast armor specification will be required to identify this type of high performance cast material for design application.

e. The execution of this project will not have significant impact on the quality of the environment.

7. Economics:

a. Prior development costs will entail Government funded testing in the amount of approximately $10,000, Project No. 1X62373DE01, to evaluate specially prepared test plates by the Blaw-Knox Company. Total PA funding contemplated for this project is 1400K (500 for FY79 and 900 for FY80). There will be an implementation cost of 300K for pattern, fixtures, and tooling in FY81.

b. The results of the economic analysis indicate the cost and benefits of advanced solidification techniques for the manufacture of cast armor is very favorable compared to existing methods.

c. The non-quantifiable benefits are improved ballistic protection, more uniform material quality, and greater dimensional reliability. The execution of this project will not violate safety standards.

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T805002 (TARADCOM) 2. PA 3197 3. Cost 275K

4. Title: MM&T: Manufacturing Methods for Fabricating Torsion Bar Springs From High Strength Steels (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

6. Summary:

a. The cross-country mobility of US Army tracked vehicles needs improvement, specifically in terms of the road wheel travel allowed in vehicles with torsion bars. To increase road wheel travel, the torsion bars must be stressed above the capacity of conventional steels. Steels able to bear these stresses exist, but techniques of manufacturing torsion bars from these steels are not established.

b. The proposed solution is to establish processing parameters for high strength steels having increased torsional strength over standard materials now being utilized. High strength steels for torsion bar springs were developed for the XM1 R&D effort. The first year effort (FY79) was directed towards optimizing production processes and fabricating torsion bars for subsequent vehicle tests. Processing parameters such as forming, heat treating, straightening, pre-setting, shop peening and spline cutting techniques were optimized. The effects of these processes were incorporated into the manufacture of full size bars for endurance validation. The second year effort (FY80) will demonstrate the feasibility of the process by vehicle validation of the torsion bars. A final report will be written.

c. The end product of Phase II will be a technical report to update the technical data package for fabricating torsion bars from high strength steels.

d. At the end of the project, changes will be initiated to the technical data package, Spec MIL-S-45387, and applicable part drawings. The initial effort will be project funded. Technical briefings and demonstrations for industry will be conducted.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. Actual cost of XM1 R&D effort for high strength materials for torsion bars is not available at present. PEM funding for FY79 - 150K; FY80 - 275K. Implementation costs will be developed at the completion of this project. The cost will be affected by the exact number and type of machine tools required to perform the machining operation on a particular tracked combat vehicle.

b. This project has the potential for increasing the performance life of torsion bars by 25% with reduced failure rate.

c. This project will not violate any safety standards.

EXHIBIT P-16 (PART I) PRODU ON ENGINEERING MEASURES (PEM) OJECT 1 JUL 1978

RCS CSCRD-105 (R1)

DUPLICATE

1. Project No. T805006 (TARADCOM) 2. PA 3197 3. Cost 150K

4. Title: MM&T: Production of Lightweight Steel Cast Track Shoes (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/USATECOM, Aberdeen, MD

6. Summary:

a. The greatest number of track shoes in the tracked vehicle fleet are the lightweight track shoes, used principally with the high mobility, lightweight combat vehicles. Since these shoes are of a lightweight design, they have a minimum of cross-sectional areas and thicknesses. Design of these track shoes makes them more difficult to forge, thus, increasing their cost.

b. Employing available high strength casting alloys and present advanced methods in molding, coring and melting practices made this thin wall cast configuration feasible and can insure reproducibility in dimensional tolerances and soundness to achieve physical properties consistent with performance requirements. R&D work has established the feasibility of the technology and demonstrated its practicability in the laboratory. In Phase I (FY79), casting parameters, mold material, gates, risers and pouring temperature were established; cast steel track was fabricated as part of the effort to scale the process up to production quantities. In Phase II, the effort is to conduct vehicle and laboratory tests to determine the integrity, quality and reliability of cast steel track fabricated in Phase I. A final report will be written.

c. The end product of Phase II will be a final report containing process specifications for cast lightweight track shoes.

d. A technical data package will be prepared for the cast track shoes to permit procurement for replacements and new buys. The process will be demonstrated for industry.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. R&D effort leading yo this PEM project was 435K (FY76-78). PEM funding for FY79 - 200K, FY80 - 150K. Implementation will be performed within the scope of this program.

b. This project will enable the Government to procure a high-demand item in a more competitive industry. Cost savings of approximately 10% can be realized. These items are bought in large numbers, approximating 1,000,000.

c. This project will not violate any safety standards.

Project No. T805006 (TARADCOM)

EXHIBIT P-16 (PART I)

RCS CSCRD-165 (R1)

1 JUL 1978

DUPLICATE

1. Project No. T805007 (TARADCOM) 2. PA 5197 3. Cost 190

4. Title: MM&T: Advanced Technology Brake Lining Materials (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/AMMRC, Watertown, MA 02172/USATECOM, APG, MD 21005

6. Summary:

a. The objective of this project is to develop processing parameters and scale-up for the manufacture of brake lining material for large wheeled vehicles. Benefits will be a brake lining of doubled life at a total ownership cost of half that of currently used lining.

b. Arresting the momentun of a large vehicle requires brake lining materials with resistance to thermal shock and mechanical wear as well as having a good damping capacity. The combination of properties is difficult to achieve. Generally, a compromise is made with a sacrifice in wear resistance. This avoids catastrophic failure but results in frequent lining replacements. Improving wear resistance without sacrificing other material requirements offers a substantial saving in replacement costs. In tests thus far, the "gridded" concept for brake linings has been shown to be comparable to conventional brake lining materials in all respects, with the exception that wear life and fading characteristics are much improved. For example, low temperature performance, damping capacity (squeal), or effects on brake drums were found equivalent to conventional materials in tests on smaller vehicles. Laboratory developments have now shown that the gridded concept can be produced in the necessary thicknesses to scale prototype development into commercial practice for the materials required for Army use. This is a second year effort of a two year program. This effort will be directed to extensive evaluation of the manufacturing processes which will include both laboratory and vehicular tests.

c. The end-item of this program will be drawings, experimental hardware, and a technical report.

d. Implementation of this process will be accomplished by the ECP procedure.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. This project is not the direct result of an R&D effort. The R&D effort was performed at Gould, Incorporated, and other private companies. The PAA cost for FY79 - 190M; FY80 - 190M. There will be no additional government costs to implement these PAA project results.

b. This project will result in approximately a 50% savings in replacement costs for brake shoes. The total cost savings is estimated to be approximately two million dollars over the life of the new lining in the vehicle fleet.

c. The performance of the project will not violate any safety standards.

Project No. T805007 (TARADCOM)

DATE: 1 ~~June~~ 78
JUL

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGRD-165 (RI)

1. Project No: T805019 (TARADCOM) 2. PA 5197 3. Cost: $290K

4. Title: MM&T: Storage Battery, Low Maintenance—Phase III

5. Facility/Contractor:

a. Facility: US Army Tank Automotive Research and Development Command, Warren, MI 48090

b. Contractor: To be selected

6. Summary:

a. Fabrication of a plastic case maintenance free military battery requires techniques for reinforcing the battery case with complex internal stiffeners without an apparent internal or external volume or dimensional change. Reinforcement material must be such so ~~or~~ not ~~to~~ cause battery acid leakage which would result in battery failure and cause considerable damage through corrosive actions.

b. 2HN tactical vehicle size battery case will incorporate the battery grid techniques, previously establishing the fabrication methods to assure production of impervious integral surfaces, with high impact strengths. Utilization of plastic battery cases was demonstrated in an R&D project in FY 74. The Phase I effort of this program provided for the adoption of dry-charged maintenance free battery plates, Phase II provided a preliminary maintenance free size 6TN military battery for heavy vehicles. This Phase III will provide a 2HN size plastic container maintenance free military battery for tactical vehicles.

c. The end product of this project will be a report describing manufacturing processes and technology for a high impact plastic container tactical vehicle type 2HN military maintenance free storage battery.

d. This PEM project will provide necessary data, technical reports of laboratory and field evaluations and preparations for TDP. No additional PEM program will be required for final implementation.

e. The execution of this project will not have a significant impact on the quality of the environment.

7. Economics:

a. An R&D effort in FY 74 for $45K resulted in the development of battery containers to determine the feasibility of using plastics to improve strength, decrease fabrication time and eliminate leakage. PEM funds of $300K were expended in FY 77 and 78 to provide the military 6TN size plastic container maintenance free battery. This PEM project funding is $290K for FY 80 for a tactical vehicle battery, size 2HN maintenance free, in a new plastic container. There will be no additional Government costs required to implement the PEM project results.

T805017

b. The results of this PEM project will extend average battery life by approximately 8%. This increase in life of the battery will reduce procurement costs by approximately 3% per year. The processes used will result in a cost savings of approximately 5% per battery because it will utilize the more readily available materials which are compatible with what is used in commercial vehicle equipment.

c. Performance of this project will not violate safety standards.

8. Item Supported:

The 2HN military batteries are used in tactical vehicles of the 1/4-ton size trucks up to 2-1/2 ton trucks.

9. Current and projected requirements:

There are no known projections for a decrease in the quantity of production support. Currently, 80,000 2HN batteries at $27.31 each are procured yearly. Presently manufacturers are unable to keep up with battery demands. With the implementation of the new plastic container battery, a decrease in battery demand would be realized due to the maintenance-free concept and the longer life of the high impact plastic container.

10. Discription of Work:

Phase I, FY 77 MM&T effort provided for the adoption of a dry-charged concept to military batteries, with the application of calcium alloy grid maintenance free plates. Phase II, FY 78 MM&T effort was funded to provide preliminary, military plastic container, 6TN size maintenance free batteries for heavy vehicle equipment. Phase III, FY 80 MM&T effort will provide all tactical vehicles up to 2 1/2-ton trucks size with a plastic container military maintenance free battery, with military drawings, specifications and all necessary data and information for TDP.

11. End Product from Project:

The end product from this FY 80 project will be a final technical report detailing performance of the 2HN size plastic container low-maintenance battery for both physical and electrical characteristics under TARADCOM, TECOM, troop and field evaluation. The final report will include data and drawings prepared for TDP.

12. Detailed Cost Summary: See Inclosure 1.

13. Time Phasing: See Inclosure 2.

14. Related Efforts: See Inclosure 3.

15. Revision Data: N/A

EXHIBIT P-16 (PART I)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T805054 2. PA 3197 3. Cost 175K

4. Title: MM&T: Laser Surface Hardened Combat Vehicle Components (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be Selected

6. Summary:

a. Tracked vehicle components are presently surface hardened by flame or induction heating methods. These methods do not hold hardened pattern dimensions because the heat energy is applied slowly and in a smaller area than required, subsequently allowing the thermal energy to be conducted to obtain the desired pattern. It is difficult to control heat treated patterns. These factors adversely affect the final utilization of the component.

b. Controlled surface hardening can be achieved by using high energy lasers to heat the surface of components precisely and to input the necessary energy in a relatively small area. The surface can be scanned by the beam precisely under automatic controls. Distortion and cracking can be held to a minimum as no quenching medium is required. In-house R&D has evaluated laser hardening of T-142 track end connectors (FY78). This is the second year effort of a two year PEM program. The first year effort (FY79) established the computer controls and energy input to satisfactorily harden components of various chemistries. This second year effort will be an evaluation of the results through vehicle trials and necessary quality assurance evaluation. A final report will be written.

c. The end products of Phase II will be a final technical and audiovisual report depicting the detailed procedures and process controls necessary to utilize laser energy to surface harden combat vehicle components.

d. At the completion of this project, changes will be incorporated as necessary into the technical data package to reflect the latest manufacturing technology. Technical briefings and demonstrations will be conducted for tank-automotive component manufacturers to establish use of this technology.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. This project is not a direct result of a major in-house R&D effort, although a small effort was funded in FY78 at 5K. The PEM funding for FY79 - 175K; FY80 - 175K. PEM implementation costs will be established as part of the project product.

b. The economic benefit is establishment of precise controls of the heat treat process to lower reject rates and to provide surface hardened components with greater precision so as to increase their reliability.

c. This project will not violate any safety standards.

Project No. T805054 (TARADCOM)

EXHIBIT P-16 (PART I)

PROD ION ENGINEERING MEASURES (PAA ROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

DUPLICATE

1. Project No. T805068 (TARADCOM) 2. PA 5197 3. Cost 200K

4. Title: MMT&: New Anti-Corrosive Materials and Techniques (Phase I

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

6. Summary:

a. Tactical vehicles currently built for the Army's wheeled vehicle fleet do not utilize the latest anti-corrosion materials because the current manufacturing technology has not been updated to utilize pre-coated sheet steel. Pre-coated steel provides a much greater degree of protection against corrosion then the current standard military protective finishes; however, production techniques and equipment are not readily available to manufacture military design equipment.

b. Current tooling for stamping, welding, and processing will be modified to manufacture vehicle components from the pre-coated steel to insure the increased corrosion protection is maintained throughout the manufacturing cycle. Trial production runs will be performed on sheet metal vehicle components to determine and establish manufacturing specifications for pre-coated steel. The use of pre-coated steel in coils presents an economical solution for the elimination of corrosion in boxed-in or enclosed components such as doors, hoods, rocker panels and other structural components (rails and cross members) where dirt and moisture can accumulate to initiate corrosive action.

c. Specification requirements will be established; prototype hardware already mentioned will be manufactured. A technical report detailing the manufacturing procedures and parameters will also be generated.

d. To implement the use of these materials and procedures, drawings will have to be changed and introduced into the applicable configuration by ECP procedures.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. This project is the direct result of R&D efforts performed by private industry. PAA funding: FY80 - 200K, FY81 - 200K. Implementation costs for drawing changes which will be applicable to PIP vehicles and new tactical vehicles will be borne by the vehicle contracts. No separate funding should be required.

b. Implementation of these innovative methods of corrosion inhibition will substantially increase the life expectancy of tank-automotive critical components, reduce replacement cost, and diminish critical down time.

c. The performance of the project will not violate any safety standards. EEOC is not applicable to this project.

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

DUPLICATE

1. Project No. T805080 (TARADCOM)   2. PA 3197   3. Cost 150K

4. Title: MM&T: Fabrication Methods for High Strength New Net Shape Aluminum Transmission Cases (CAM) (Phase II)

5. Facility/Contractor: USATARADCOM, Warren,MI 48090/Contractor to be Selected

6. Summary:

a. Transmission cases are unique in that they are long thin walled castings. The sections used present difficulties in casting. Dimensional and metallurgical reliability variation from casting to casting results in additional assembly time and machining costs. Reliable net shape casting processes would reduce many expensive machining operations and costs.

b. Dimensional reproducibility will be established by instituting a program of interrelated process controls. Phase I (FY79) of the program established the configuration and dimensional factors that affect the variations in casting of transmission cases incorporating the typical design features. A basis for predicting statistically the variations to be expected in production castings was determined. Work on interrelation of control and metallurgical factors has been initiated. Phase II (FY80) will complete the evaluation of these factors. Emphasis on effect of introduction of reinforcing materials will be emphasized to establish reliability of production techniques for use of advanced materials. Production cases will be fabricated for laboratory and field trials to demonstrate the application of the data on a production run. A final report will be written.

c. Phase II will produce a technical report with information for adaptation of these techniques to production of all types of transmission cases. Information from this project will also be incorporated into the technical data package as needed.

d. At the completion of the project, changes will be initiated to the technical data package. The initial effort will be project funded. The process control method will be demonstrated to fabricators of these components.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. There was no R&D effort leading to this PEM project. PEM for FY79 - 325K; FY80 - 150K. It is not foreseen at this time that any additional cost will be required to develop the PEM project results.

b. The project has the potential for reducing costs of transmission cases by as much as 20%.

c. The project will not violate any safety standards.

Project No. T805080 (TARADCOM)

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

DUPLICATE

1. Project No. T805081 (TARADCOM) 2. PA 3197 3. Cost 210K

4. Title: MM&T: Fabrication of Friction Rings and Reaction Plates (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be Selected

6. Summary:

a. The manufacturing of transmission friction rings and reaction plates produces large amounts of scrap in the form of flashing. This flashing becomes quite voluminous and represents an undesireable initial invesment in material. It is desired that the amount of scrap (flashing) be materially reduced.

b. The amount of scrap will be reduced by using an entirely different technique for production. Instead of stamping out the rings and plates, they will be rolled from strip steel, virtually eliminating all scrap. R&D work was not a fore-runner to this project. Phase I of this project was successful in finalizing the welding procedures and edge roll technology in addition to the heat treating and nitriding. This project (Phase II) will consist of full-scale metal-working process, process acceptance, and produce validation. A final report will be written.

c. End products of Phase II will include a technical report plus validation of parts. The technical data package will be updated to permit making friction rings and reaction plates by this process.

d. Demonstrations of the fabrication procedure to prospective contractors would assure acceptance and implementation into their own production.

e. Execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. There have been no government sponsored R&D efforts in this area. In FY79 PEM funding was 215K on Phase I of this effort. Cost for Phase II, FY80, is 210K. No additional costs for implementation are anticipated.

b. Scrap losses will be reduced from 65% to 2% annually.

c. This project will not violate any safety standards.

EXHIBIT P-16 (PART I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT RCS CSCRD-165 (R1) 1 JUL 1978

DUPLICATE

1. Project No. T805082 (TARADCOM) 2. P 3197 3. Cost 880K

4. Title: MM&T: Flexible Machining Systems (FMS) Pilot Line for TCV Components (CAM) (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090, Contractor to be Selected.

6. Summary:

a. It is recognized that items manufactured in large numbers using mass production technology (automation) cost less per item than the same item produced in small quantities. Parts for tracked combat vehicles are rarely procured in quantities which permit the benefits of mass production to be realized. Thus, TCV parts are extremely expensive to produce.

b. The advantages of mass production can be brought to the production of items procured in medium size quantities (1,000 to 100,000 parts) by a concept known as a "Flexible Machining System". This concept, when employing computers and coupled with simplified mass production type tooling can introduce a level of flexibility which will enable it to handle a number of suitably selected similar parts with very nearly the same efficiency as is achieved in mass production. The Phase I effort (FY79) was coordinated with the contractor who has a prototype FMS system. This FMS system was observed to determine efficiency, problems in software programming and opportunities for system optimization. The Phase II effort (FY80) will continue software optimization and will produce generic specifications of software and hardware. Phase III will conclude the Phase II effort and examine adaptive control systems to enhance FMS performance. A final report will be written.

c. The end product of Phase II of the project will be the generic specifications required for procuring an FMS system.

d. Phase III will verify the optimized software developed in the prior phases and will identify adaptive control technology that could further improve FMS performance. Project results will address second facilitization for XM-1.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. FMS has not received any R&D effort. Project funding under PEM for FY79 required 440K. FY80 fund requirements will be 880K and for FY81, funds will be 880K. No additional funds will be required for implementation.

b. The implementation of an FMS system can be expected to reduce the costs of items machined by at least 55%.

c. This project will not violate any safety standards.

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

DUPLICATE

1. Project No. T805088 (TARADCOM) 2. PA 3197 3. Cost 250K

4. Title: MM&T: High Power Electron Beam Welding in Air (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be selected

6. Summary:

a. Current combat vehicle fabrication methods require extensive joint preparation, fit-up and fixturing which contribute to labor-intensive fabrication costs. Manpower costs have escalated to such a level that new fabrication techniques become attractive as potential cost savings methods. Vacuum EB welding requires higher implementation cost (large vacuum chamber) and lengthy pump-down times which increases overall fabrication costs.

b. Under MMT Project No. 4744330, 4754330 and 4764330 using existing contractor facilities and available vacuum chambers, aluminum armor test plates were fabricated and ballistically tested, a plan developed to fabricate a hull approximating full size and then fabrication of the hull to demonstrate fabricability. Unlike prior efforts, this project will perform welding in air without benefit of a chamber. Non-vacuum Electron Beam welding was demonstrated on a limited basis. (commercial/industrial R&D). Phase I consisted of welding studies conducted on aluminum armor materials to establish welding parameters and procedure necessary to assure quality of welded joints and service reliability. Phase II will consist of fabrication of full size hull structures and testing in a simulated service environment (vibration).

c. The end product of this project will be a final technical report showing feasibility and welding procedures required to join aluminum armor in air with the EB welding process.

d. The welding process will be available to PM/Contractors as a viable method of joining aluminum armor as applied to combat vehicles.

e. The execution of this project will not have a significant impact on the quality of the environment.

f. Project Officer: Donald E. Phelps, DRDTA-RCKA, AV: 273-2433.

7. Economics:

a. The total PA funding for this project is 250K FY79, 250K FY80. There will be an implementation cost of 600K for Electron Gun/Power Source, Positioning Fixture and Shielded Welding site.
b. The results of the economic analysis (See Incl 5) indicate the cost and benefits of this program are favorable with respect to other aluminum armor fabrication methods.
c. The performance of this project will not violate any safety standards.

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

DUPLICATE 1 JUL 1978

1. Project No. T805090 (TARADCOM) 2. PA 3197 3. Cost 290K

4. Title: MM&T: Improved and Cost Effective Machining Technology (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be Selected

6. Summary:

a. Many tracked combat vehicle (TCV) components are subject to high recurring costs and long lead times. This is typically the result of poor manufacturing system performance when the choice of machining technology is made without the benefit of specific machining data. The lack of data leads to the selection of costly tooling and inefficient metal removal.

b. This problem will be solved by establishing improved and cost effective combinations of cutting tools, cutting fluids and machining conditions such as speed, feed and depth of cut for each of the important machining operations and grades of material employed in TCV parts. Phase I (FY79) established cost-effective means for end and face milling, drilling, reaming and tapping TCV parts. Phase II (FY80) will establish means for rough and finish turning facing, and boring these parts. Phase III (FY81) will establish means for grinding, gear cutting and broaching. A final report will be written.

c. The end product of Phase II will be a report on machining data for turning, facing, and boring TCV parts.

d. Technical briefings and demonstrations will be conducted so that companies engaged in Tank-Automotive work will obtain a first hand knowledge of the machining data available.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. There have been no previous R&D efforts in this area. Project funding under PEM was 315K for FY79 and will be 290K for FY80 and 290K for FY81. Additional costs for PEM implementation are not foreseen at this time.

b. The selection of improved and cost effective machining conditions made possible from the data developed in the project is expected to reduce recurring machining costs by 20%. The saving in machining time provides a benefit in the form of increased capacity without an increase in capital investment plus a reduction in lead time and improved schedules.

c. This project will not violate any safety standards.

EXHIBIT P-16 (PART I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT 1 1 JUL 1978

RCS CSCRD-165 (R1)

DUPLICATE

1. Project No. T805091 (TARADCOM) 2. PA 319 3. Cost 420K

4. Title: MM&T: Heavy Aluminum Plate Fabrication (Phase I)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/Contractor to be Selected

6. Summary:

a. Many combat and tactical vehicle hulls and their components are fabricated from large thickness aluminum plate. The problem being addressed is the high labor content in cutting heavy aluminum plate to given contours and joining such pieces by welding.

b. The proposed solution is to cut heavy aluminum plate rapidly by the plasma arc process using numerical control and to establish rapid joining procedures for the thick plate after plasma cutting by using electron beam, gas metal arc, or gas tungsten arc welding. Mutations of these welding processes have been designed in private industry for the welding of thick aluminum plate. Phase I of the project will determine optimum procedures for plasma cutting of thick aluminum plate. Process parameters will be established for gas metal arc, gas tungsten arc and electron beam welding of heavy aluminum plate. A report will be written. Phase II will consist of cutting aluminum plate, welding a typical full-scale vehicle structure, subjecting this structure to simulated service, and writing weld procedures and specifications. A final report will be written stating the results of the project.

c. The end product of Phase I will be a report, procedures and specifications for improved and less labor-intensive methods of cutting and welding of heavy aluminum plate.

d. Briefings and demonstrations in conjunction with the dissemination of the final report to all interested governmental and private agencies will assure implementation at the earliest possible date.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. There have been no previous government sponsored R&D efforts in this area. Project funding under PEM will be 420K for FY80 and 180K for FY81. No PEM implementation costs are foreseen at this time.

b. The selection of improved and cost effective cutting and welding processes for heavy aluminum plate established by the project is expected to reduce fabrication costs by 30%. This savings in time and monies will provide benefits in the form of reduced lead times and improved scheduling.

c. This project will not violate any safety standards.

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (RI)

1. Project No: 1807052(AVRADCOM) 2. PA: 1497 3. Cost: 250

4. Title: MM&T - Ultrasonically-Assisted Cold Forming of Titanium Nose Caps and Other Similar Forms and materials

5. Facility/Contractor: US Army Aviation Systems Command, Directorate for Research, Development and Engineering, Systems Concepts and Technology Division, Production Technology Branch, St. Louis, MO, and private contractors to be selected.

6. Summary: This is a two year MM&T effort to perfect the cold forming of titanium sheet as a cost effective production technique when applied to helicopter dynamic structures. The objective of this project will be to develop and optimize the ultrasonic pull forming technique parameters and to determine the magnitude of the cost savings of ultrasonically assisted titanium forming over conventional stretch forming and draping at high temperature. Ultrasonically assisted forming of titanium and aircraft quality aluminum alloys can reduce the cost and increase the speed of forming of titanium and aluminum sheet.

The end product of this project will be the establishment of a process for ultrasonically assisted forming of titanium sheet for aircraft structures.

Prior R&D has been conducted by Sonobond Corporation. The feasibility of the cold forming of titanium has been established pursuant to the titanium tube drawing process as perfected by the Sonobond Corporation.
Project Liason: M. Kornitzky DRXMR-PT AV 955-3524.

7. Economics: The first year effort will investigate the use of ultrasonic wedge-reed spot welding system for continuous cold forming aluminum and titanium sheet materials.

The problem associated with conventional cold forming is the limited formability of certain high strength alloys. The problem associated with hot forming include the surface oxidation and corrosion effects which must be removed mechanically and/or chemically.

This project will greatly benefit the Government by reducing the cost of fabrication of helicopter blade leading edges and other airfoils or bent structural elements. Ultrasonically assisted cold forming will obviate the need for expensive chemical etching systems and may permit final thickness materials to be used from the start. Bulk materials savings of 20% or more are expected.

Successful completion of this development will provide building blocks for a variety of forming applications wherein revised tooling will be the major change required. Once the ultrasonic system array has been defined, no additional ultrasonic equipment will be required to increase the length of formed items. Hence, longer formed pieces will cost less per foot to fabricate.

EXHIBIT 6 (Part I)

DUPLICATE

DATE: 1 JUL 1978

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. : 1807155 (AVRADCOM) 2. PA: 1497 3. Cost: $375

4. Title: MM&T: Cost Effective Manufacturing Methods for Improved High Performance Helicopter Gears

5. Facility/Contractor: U. S. Army Aviation Systems Command, St. Louis, Missouri, 63166. Contractor to be selected.

6. Summary: The demand in helicopter operation for greater reliability of high performance gears at lower costs has required that improved processing and evaluation techniques be instituted. This program is concerned with one such improved method, austrolling, in combination with imporved nondestructive evaluation methods to provide a viable solution for optimizing quality, reliability, and cost. MMT efforts of prior years (Projects 1748148, 17568148) have emphasized the optimization of heat treatments of gears fabricated in commercially available AISI 9310 and modified VASCO X-2 steels. As a result of these efforts, heat treatment processing variables such as carburizing, austenitizing and tempering procedures have been established. However, to insure effective implementation, it is required that quality control be incorporated in specifying steels for high performance gear applications. Accordingly, one aspect of the program would be to utilize previously developed computerized ultrasonic nondestructive testing techniques for quality control in every stage of processing. This control coupled with improved metal production, such as electro-slag remelt, and double vacuum induction/vacuum arc remelt in conjunction with unique metal fabrication methods, typified by austrolling and cold finish rolling gears, should result in significant improvements in quality and reliability at lower cost. The program will address the manufacture of new spur and helical gears with implementation taking place through carefully structured test and evaluation procedures (e.g. four-square and transmission stand test procedures) that duplicates service environment. This technology will be transferred to gear producers and helicopter manufacturers such as Boeing-Vertol, Sikorsky, etc. Based on these efforts, a Gear Producibility and Technical Data Package (Guide) for High Performance Gears will be written and provide as a basis for implementation of these processes in aircraft such as UTTAS, AAH, and CH-47 Mod where the decision to use material such as 9310 or VASCO X-2 steel has been made.

7. Economics: (a) This project is the third year of a three year MMT program totalling $961,000 (FY78-$461,000; FY79-$125,000; FY80-$375,000). (b) AMMRC R&D efforts in the AH84 Materials RDT&E program have emphasized the individual mechanisms that are important to the various phases of this project. (c) The program will also give emphasis to material quality from the initial stages of steel production to the final phase of gear fabrication using improved nondestructive evaluation methods. Due to less reliance on grinding there will be significant cost reduction in the production of gears. It is estimated that the cost savings will amount to over $13,000,000. There are additional benefits arising from the following: improve reliability due to the ability to crown gears, eliminate finishing by grinding that will reduce the scrap rates and improve the surface quality; and the ability to apply these procedures to the refinishing of gears removed at overhaul. (d) The execution of this project will not have a significant effect on the quality of the environment (See Inclosure 2, Environmental Assessment Statement).

EXHIBIT P-16 (Part 1)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

RCS CSCRD - 165 (R1)

Date: 1 July 1978

Project No. 1807197

RECEIVED 5 JUL 1978

1. Project No.: 1807197 (AVRADCOM) 2. PA: 1497 3. Cost: $250K

4. Title: Fabrication of Integral Rotors by Joining

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Ft Eustis, VA, cooperatively with the Air Force Materials Laboratory and an independent contractor(s) to be determined.

6. Summary:

a. This program will establish the manufacturing technology for fabrication of integral turbine rotors by joining the blades and disks by metallurgical bonding.

b. R&D has been performed by private industry to demonstrate the suitability of several joining techniques for producing sound metallurgical bonds. Many bond joints with both similar and dissimilar materials currently exist in many gas turbine engines and in highly-stressed areas. Specifically, integral turbine rotors formed by bonding techniques have been engine tested at several gas turbine engine companies. The Bonding Process Development task of this effort was conducted by the Air Force Materials Laboratory during FY78 cooperatively with ATL.

c. Current gas turbine rotor fabrication is limited to either (1) the integrally cast rotor which has limited experience and does not permit obtaining optimum mechanical properties in both the blade and disk or (2) the separate blade and disk attachment which requires complex and expensive machining of both the blade and disk and creates a potential life problem due to stress concentrations that arise. The use of a bonded blade and disk permits the separate generation of optimum mechanical properties in the blade and disk and eliminates the expensive machining required for mechanical attachments. The capability to inspect and repair/replace damaged parts has been demonstrated by the gas turbine industry.

d. Principal Investigator: Jan M. Lane, Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), ATTN: DAVDL-EU-TAP, Ft Eustis, VA 23604, AUTOVON: 927-2771, Commercial: (804) 878-2771.

7. Economics:

a. This project is the third-year of a four-year MM&T program totaling $350,000 (FY77, $300,000; FY79, $100,000; FY80, $250,000; FY81, $200,000) plus approximately $1,750,000 of Air Force Funding.

b. R&D effort supporting this program has been conducted by several gas turbine engine companies under Independent Research and Development and company in-house funding.

c. This new method of rotor fabrication will reduce costs by elimination of the expensive machining in the attachment area as well as permit the selection of mechanical properties to be based on blade airfoil and disk bore requirements rather than attachment requirement and improve life and material utilization. Additional cost savings can be realized by elimination of cooling plates or blade retention disks common to many engines. Based on the T700 engine buy alone and only the reduced machining, the anticipated discounted net savings is $1,688,200. Including the reduction of parts requirement, the total discounted net savings is $2,927,800. (See Inclosure 1, Economic Analysis)

d. The execution of this project will not have significant effect on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement)

EXHIBIT P-16 (Part I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

RCS CSCRD - 165 (R1)

Date: 1 July 1978

Project No. 1807199

1. Project No.: 1807199   2. PA: 1497   3. Cost: $250K

4. Title: MM&T: Surface Hardening of Gears, Bearings and Seals by Lasers

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Technology Applications Division, Propulsion Technical Area, Ft Eustis, Virginia, cooperatively with the Air Force Materials Laboratory and private contractor(s) to be selected.

6. Summary:

a. This project will establish manufacturing technology for surface hardening the teeth of spur gears (now case carburized), the races of ball bearings (now through hardened), and the runners of contact seals (now ground and polished). The bearing effort is under the aegis of the Air Force Materials Laboratory (AFML) with technical and financial support from the Army.

b. The R&D related to this project was conducted by private industry with corporate funds.

c. Case carburizing is expensive--requiring much energy, quenching dies, and final grinding. Through hardened bearings lack impact strength and fracture toughness needed for survivability; they cannot be case carburized nor induction hardened. The end products of the project include technical reports and manufacturing technology applicable to laser hardening of gears, bearings and seals. These will be disseminated to industry and other Government agencies.

d. Principal Investigator: Daniel E. Pauze, Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), ATTN: DAVDL-EU-TAP, Ft Eustis, VA 23604, AUTOVON: 927-2771, Commercial: (804) 878-2771.

7. Economics:

a. This project is the third year of a three-year MM&T program totaling $650,000 (FY78, $200,000: FY79, $200,000; FY80, $250,000). FY78 funds totaling $100,000 MIPR to AFML for developing the process of surface hardening the races of ball bearings.

b. R&D effort expended by private industry is applicable to this project.

c. This new method will reduce costs by reducing the energy required to heat treat, eliminate the quenching process with the attendant quenching dies, and provide the potential for eliminating final grind. Based on the T700 engine buy for main rotor bearings and seals only, the anticipated net savings is $297,000. The inclusion of engine accessory drives and helicopter transmissions will further increase the savings.

d. The execution of this project will not have a significant effect on the quality of the environment.

EXHIBIT P-16 (Part I)

B

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (RI)

DUPLICATE

RECEIVED 5 JUL 1978

1 JUL 1978

1. Project No.: 1807240 (AVRADCOM) 2. PA: 1497 3. Cost: $235

4. Title: Machining Methods for ESR 4340 Steel for Helicopter Applications.

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertown, MA, Hughes Helicopters, Culver City, California.

6. Summary:

a. Electroslag remelted (ESR) 4340 steel is currently being employed in 58 critical operating parts of the YAH-64 Army helicopter. Since the high quality of this steel permits its use at higher strength levels than conventionally processed steels, the machining techniques required to produce these items have not been clearly defined thus causing considerable machining problems which have resulted in costly consuming inefficient machining practices. Developing the conventional and unconventional machining methods for high strength (ESR) steel is necessary to alleviate the existing machining problems associated with this new material.

b. Machining methods will have to be investigated to establish the techniques necessary to fabricate the ESR steel helicopter components. This would include the development of unconventional machining procedures in FY80 as well as the conventional machining practices developed under project 1787240 and 1797240.

c. The end product of this project will be the development of a manufacturing method and technology that can be used for machining ESR steel more successfully.

d. After completion of this program, the machining processes developed will be implemented wherever possible. Areas of consideration will include helicopter applications such as bell cranks, push rods, hydraulic actuator valve bodies and other components which may be applicable. It is expected that return on investment will be realized by substituting ESR steel for similar grade material from more costly casting processes.

7. Economics:

a. Funding: FY78 - $130,000, FY79 - $75,000, FY80 - $235,000

b. The R&D effort was funded by private industry.

c. Successful completion of this program will establish the availability of a new family of material having more ballistic resistant qualities than existing steels. The use of this material will offer considerable advantages over other steels in both monetary savings and also better personnel protection. Cost savings will be realized in less rejection and replacement of parts in service due to the better mechanical and ballistic properties of these materials. (See Inclosure 1, Economic Analysis).

d. Execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement).

 DATE: 1 JUL 1978

B

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: 1807241 (AVRADCOM) 2. PA: 1497 3. Cost: 524

4. Title: MM&T - Hot Isostatic Pressed Titanium Castings

5. Facility/Contractor: Army Materials & Mechanics Research Center, Watertown, MA 02172 and contractor to be selected.

6. Summary:

a. This project will establish the manufacturing process for hot isostatic pressing (HIP) of a cast Blackhawk titanium rotor hub. This effort will include post pressing heat treatments to improve fatigue strength to match that of the current forgings.

b. Prior R&D has been performed by Sikorsky Division of United Technologies with internal funding. HIP and beta heat test applied to titanium castings have shown the capability of producing a product close to net shape with the properties of a similarly heat tested forging.

c. The current method of manufacturing of rotor hubs results in excessive use of materials and machining. The successful completion of this project will reduce material waste alone by approximately 475#. Initial tests on HIP cast titanium indicates that the property levels required for the hub can be obtained. The resultant hubs will be used for small scale specimen testing, for development of NDT techniques and by full scale testing, characterized and qualified for production use. The end product of this effort will be a data package of the production method for HIP casting of a rotor hub. Cost savings are realized from a machining reduction of 85%.

7. Economics:

a. This is a 36 month project estimated to cost $1250K (FY78 - $126K; FY79 - $600K; FY80 - $524K).

b. The R&D effort was funded by private industry.

c. Successful completion of this project will decrease rotor hub costs. (See Inclosure 1, Economic Analysis).

d. Execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental/Assessment Statement).

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DUPLICATE

1 JUL 1978

RECEIVED 6 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (RI)

1. Project No. 1807248 2. PA: 1497 3. Cost: 5[illegible]

4. Title: MM&T - Closed Loop Machining T700 Mid Frame

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertonw, MA 02[illegible]2 and contractor to be selected.

6. Summary:

a. This project will develop machine sensing using linear transducers that will automatically compensate for any deviation in numerical controlled (NC) programmed plan, therby reducing production costs. The system will automatically make tool corrections and feed back measured dimensional data by integrating automatic inspection with NC machining via the use of a computer with accuracy and repeatability of .0002 inches. Upon completion of the operation, a print out of actual part size for quality records could be made. GE is using a transducer system for two axis measuring called an "Omniducer." This will be modified and incorporated into T700 machine system.

b. Prior R&D was performed by General Electric with internal funding.

c. The requirements on the T700 engine is to machine the mid-frame. The mid-frame has 22 diameters with tolerances ranging from ± .00025 to ± .001 inches. These tolerances result in high machining, rework and inspection costs. The application of closed loop machining will reduce these. The proposed system will be adaptable to all turbine engines including the 800 HP engine.

The end product of this effort will be a closed loop system for machining jet engine components.

d. Project Liaison: Mr. Kornitzky, DRXMR-PT, AV 955-3524.

7. Economics:

a. This is a three year effort totaling $1228-- FY79 - 423K, FY80 - 500K, FY81 - 305K.

b. The R&D effort was funded by private industry.

c. The successful completion of this project will decrease the costs of the T700 engine used on the Black Hawk & YAH64 (See Inclosure I, Economic Analysis).

EXHIBIT P-16 (Part 1)

Date: MAY 1 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

Project No. 1807285

DUPLICATE

RCS CSCRD - 165 (R1)

1. Project No: 1807285   2. PA: 1497   3. Cost: $250K

4. Title: Cast Titanium Compressor Impellers

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Ft Eustis, VA, cooperatively with the Air Force Materials Laboratory and an independent contractor to be determined.

6. Summary:

a. The problem. Current centrifugal compressor impellers are fabricated by machining the flowpath and blade surfaces from a forging. This results in a substantial loss of material and expensive machining operations.

b. The solution. This program will establish the manufacturing technology for fabricating titanium compressor impellers by casting and hot-isostatic-pressing. This process will replace the current method of machining impellers from forged billets. R&D has been done by several gas turbine engine manufacturers under IR&D funding. Additionally an AMMRC sponsored program with Solar Turbine International demonstrated the feasibility of casting titanium impellers.

c. The end products. The program will demonstrate the pilot production capability to cast and hot-isostatically press centrifugal impellers to near-net shape.

d. The implementation. Technology gained from this project will be disseminated to industry and other government agencies by distribution of reports and presentation of briefings.

e. The principal investigator for this project is: Michael R. Galvas, Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), ATTN: DAVDL-EU-TAP, Ft Eustis, VA 23604, AUTOVON: 927-2771, Commercial: (804) 878-2771.

7. Economics:

a. This project is the third year of a three year MM&T effort totaling $700,000 (FY78, $150,000; FY79, $300,000; FY80, $250,000). Additionally, Air Force funding totaling $450,000 (FY78, $100,000; FY79, $200,000; FY80, $150,000) is projected.

b. R&D effort conducted by several gas turbine engine manufacturers under IR&D funding demonstrated the feasibility of casting titanium compressor impellers.

c. The new method of fabrication will reduce production costs by 40 percent - 50 percent by substantially reducing the waste of billet material and reducing machining costs compared to a conventional forging process. Based on a production buy of 2500 (estimated) 800 Shaft Horsepower Advanced Technology Demonstrated Engines (ATDE) and a 40 percent reduction in impeller manufacturing costs, the estimated net discount savings are $3,081,000. Assuming a less conservative 50 percent cost reduction, the estimated net discount savings are $4,001,400 (See Inclosure 1, Economic Analysis).

d. The execution of this project will not have a significant impact on the quality of the environment.

EXHIBIT P-16 (Part I) DUPLICATE

DATE: 1 JUL 1978
PROJECT NO.: 1807286

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: 1807286 2. PA: 1497 3. Cost: $130

4. Title: MM&T: High Quality Superalloy Powder Production for Turbine Components

5. Facility/Contractor: Army Materials & Mechanics Research Center, cooperatively with the Air Force Materials Laboratory and a contractor to be named.

6. Summary:

a. This project will establish an improved industrial procedure for producing high quality superalloy powders to be used in the manufacture of gas turbine engine hardware.

b. With the commitment of gas turbine engine manufacturers to the production of engine hardware from superalloy powders, the need to improve powder cleanliness has been recognized. Reducing the level of non-metallic inclusions and thermally-induced porosity (TIP) will increase the yield of useful powder form the powder manufacturing process and will permit higher design strength limits for many alloys. This project will reduce the introduction of impurities to the powder at all possible stages in the process, beginning with ingot melting.

c. This project will provide an economic return through increased yield of high quality superalloy powder and through the permitted use of higher design strength limits.

7. Economics:

a. This project is the third and final year of a three year MM&T program funded jointly by the Army and Air Force, totalling $1,208,000 (Army: FY78, $220,000; FY79, $358,000; FY80, $130,000 - Air force: FY78, $0; FY79, $250,000; FY80, $250,000).

b. The need for this project was identified during an AVSCOM MM&T project titled, "Development of Hot Isostatically Pressed Rene 95 Turbine Parts (Contract DAAJ02-73-C-0106), which supported the first introduction of as-HIP superalloy hardware to a gas turbine engine (T700). It is anticipated that a substantial economic return due to higher permitted design strengths.

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EXHIBIT P-16 (Part 1)

Date: JUL 1 1979

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

Project No. 1807291

RCS CSCRD - 165 (R1)

1. Project No: 1807291 2. PA: 1497 3. Cost: $240K

4. Title: Titanium Powder Metal Compressor Impeller

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Ft Eustis, VA, cooperatively with the Air Force Materials Laboratory and a contractor to be determined.

6. Summary:

a. The problem. Centrifugal compressor impellers are typically produced by machining the flowpath and blades from oversized forgings. This results in a subtantial loss of material and expensive labor operations.

b. The solution. This program will develop the technology to hot-isostatically-press a near-net shape centrifugal compressor impeller from titanium powder. The R&D related to this project was conducted by the Air Force and by a private contractor under IR&D. The R&D demonstrated that powder metal impellers can be manufactured to correct dimensional tolerances and with mechanical properties superior to AMS4928 minimum specifications.

c. The end products. Pilot production capability to hot-isostatically-press titanium compressor impellers will be demonstrated.

d. The implementation. The technology gained from this program will be disseminated to program manager for implementation into applicable systems.

e. The principal investigator for this project is: Jan M. Lane, Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), ATTN: DAVDL-EU-TAP, Ft Eustis, VA 23604, AUTOVON: 927-2771, Commercial: (804) 878-2771.

7. Economics:

a. This project is the second year of a two year MM&T program totaling $480,000 (FY79, $240,000; FY80, $240,000) Additionally, Air Force funding totaling $560,000 (FY78; $360,000; FY80, $200,000) is projected.

b. R&D for this project has been conducted by the Air Force and a gas turbine engine manufacturer under IR&D.

c. This project will result in a new method for manufacturing centrifugal compressor impellers. The powder metallurgy consolidation method will increase material utilization and reduce machining costs compared to current forging methods. Based on the approved buy of BLACK HAWK auxiliary power units, with introduction of the developed production process in 1983, the estimated net discount savings are $502,600 (See Inclosure 1, Economic Analysis). Additional cost benefits are available from implementation of this process into the AAH, 800 SHP ATDE, Navy LAMPS, and Air Force cruise missile programs.

d. The execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement).

EXHIBIT P-16 DATE: 1 JUL 1978 A

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSRD - 165 (R1)

1. Project No.: 1807298 (AVRADCOM) 2. PA: 1497 3. Cost: $150K

4. Title: MM&T: High Temperature Vacuum Carburizing

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertown, MA 02172. Contractor(s) to be specified later.

6. Summary:

a. Gear carburizing is presently carried out with a relatively slow endothermic process, typically at 1700F, which requires surface protection against decarburizing during the cycle or a post heat treat removal of the decarburized layer.

b. This project will establish high temperature vacuum carburizing as an alternative to current production methods. By raising the process temperature, the length of the process cycle will be shortened, yielding an economic advantage. The use of a vacuum carburizing apparatus avoids the need for pre-treating surfaces, particularly important for higher alloy steels, and yields an energy saving because vacuum furnaces are only operated for the duration of the process cycle.

c. The proposed effort involves a comparison of several alternate suppliers of vacuum carburizing technology. Carburized test specimens and gears will be evaluated at AMMRC and by one or more helicopter manufacturers for implementation purposes. Certification of vacuum carburizing as an alternate to gas carburizing for high performance helicopter applications will be sought.

7. Economics:

a. The MM&T effort is the second year of a three (3) year program with a total funding of $550,000. (FY79 - $150,000 ; FY80 - $150,000; FY81 - $250,000).

b. Vacuum carburizing is currently widely used as a substitute for endothermic gas carburizing in many applications of a less critical nature than for high performance gear applications in helicopters. The certification of the process for high performance gear applications will be advantageous for Army helicopters.

c. The vacuum carburized gears will satisfy all the performance standards of endothermic gas carburized gears at a savings both in energy expended and in the cost to produce. The average savings is expected to be about $13.50 per gear. In addition to this, there is expected to be a 75 pct. energy savings.

d. The execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement).

DUPLICATE

1 JUL 1978

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (R1)

1. Project No.: 1808116 (AVRADCOM) 2. PA: 1497 3. Cost: $160

4. Title: MM&T - Product of Erosion Resistant Coatings for Titanium Alloy Compressor Components

5. Facility/Contractor: a. Army Materials and Mechanics Research Center, Watertown, MA 02172

b. Industrial Contractor to be selected.

6. Summary: (a) This project will establish the manufacturing methodology, materials specifications and quality assurance methods for the production of an erosion-resistant titanium carbonitride or titanium diboride coating on titanium compressor hardware (rotor blades and centrifugal impellers) used in retrofitting Army helicopter T-53 and T-55 gas turbine engines and projected 800-SHP ATDE units. Recent T-55 engine tests (1974) at AVCO-Lycoming have verified the need for upgrading the erosion resistance of titanium compressor blades.

(b) Titanium carbonitride and titanium diboride coating systems, with demonstrated dust erosion resistance, have been developed in earlier R&D investigations. Subsequent studies showed the feasibility of coating full-size centrifugal impellers and rotor blades. This proposed effort involves the production scale-up of the laboratory process, the design and construction of a pilot facility and the evaluation of coated hardware in a helicopter test engine rig incorporating controlled dust-ingestion characteristics.

(c) The end products will include technical reports, processing manuals and specifications for applying erosion resistant coatings to titanium gas turbine compressor components.

(d) Implementation: Action will be taken to disseminate the results to the various project managers and other government agencies by both reports and briefings.

7. Economics: (a) New Project. This project will cost $160K in FY80 and $160K in FY81.

(b) In FY78, titanium carbonitride studies were continued under Contract No. DAAG46-77-0057 ($50K).

(c) This project will result in a savings of $1.6M per year based on 2,000 engine overhauls a year. (See Inclosure 1, Economic Analysis).

(d) The execution of this project will not have a significant effect on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement).

Exhibit P-16 (PART I)

DATE: 1 June 1978

PROJECT ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

8152

1. Project No. 5801001 2. PA 4250 3. Cost $250

4. Title: MMT, "Pilot Line for Fuze Fluidic Power Supplies"

5. Facility/Contractor: Harry Diamond Laboratories (DELHD) 2800 Powder Mill Road, Adelphi, MD 20783
Contractors to be selected from qualified offerors.

6. Summary: a. PROBLEM - Proper operation of present design for fluidic generators, which are now being utilized as power supplies for a variety of rockets and bombs, depends largely on a complex geometrical configuration in which allowable dimensional deviations and interplay between component parts are extremely critical. In production, the requirement for close tolerance fabrication and assembly of precision parts is reflected in unnecessarily high manufacturing costs and low yield for those devices.

b. SOLUTION - The purpose of this project is to ~~identify and adopt~~ establish the most economical manufacturing processes and techniques available for the establishment of a mechanized pilot assembly line for the production of fluidic power supplies. This will include the design and fabrication of special dies for the stamping, forming and die casting of metal parts from alnico, steel and aluminum, special molds for the forming of plastics required for the manufacture of critical parts, and assembly techniques and fixtures that will reduce the cost and complexity of tedious assembly, adjustment and calibration processes prevalent in the R&D program.

c. END PRODUCT - A pilot line for the manufacture of selected parts, such as, ring nozzles, slotted collars, magnets and diaphragms as well as for assembly procedures and required fixturing for critical components. In addition, a complete manufacturing report, including drawings of all equipment will be prepared.

d. IMPLEMENTATION - The pilot line which will result from this project will, in itself, provide a limited production capability in support of the General Support Rocket System (GSRS). It will be further supplemented by production funds to build up production rate to levels required by the GSRS program. Technical point of contact for this project is Dr. Carl Campagnuolo, AV 290-3193.

7. Economics:

a. Costs:	FY75	FY76	FY77	FY78	FY79	FY80	FY81
PEMA	0	0	0	0	0	250	250
R&D	35	50	35	35	0	0	0

b. Summary of economic analysis: Because of the classified character of the GSRS program, generator savings can only be stated for the total projected procurement. On this basis, an absolute savings of more than one million dollars is anticipated in the course of GSRS generator production as a result of this MM&T program and expenditure. When discounted according to each year of production, the savings calculate to 1.3 times the cost of the MM&T program. In addition, future savings can be expected from the 2.75" rocket and Navy programs.

c. Environments: The environmental consequences of this project have been assessed and the approved EIA, dated 5 April 1977 is attached. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

PROJECT NO. 5801001 (ARRCOM)

DUPLICATE

8097
EXHIBIT P-16 (PART 1) 1 APR 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (R1)

RECEIVED 4 MAY 1978

1. Project Number: 1903 (ARRCOM) 2. PA: 4250 3. COST: $1187K

4. Title: Die Cast Tailcone for BLU-96/B

5. FACILITY/CONTRACTOR: Naval Weapons Center, China Lake/Honeywell, Inc.

6. SUMMARY: a. Problem:

The Blu-96/B Tailcone should be die cast to reduce machining and lower the unit cost.

b. Solution: Develop an articulated die for 2000 ton die cast press.

c. End Product: A die casting die suitable for making the BLU-96/B Tailcone.

d. Implementation: Acceptance testing and implementation will be at contractors plant.

e. Environmental Impact Statement: The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

f. There are no OSHA requirements in this project.

7. ECONOMICS: a. Total project cost is estimated to be $1187K to be funded as follows:

FY80 = $1178K
FY81 = 9K

These costs include installation and implementation at the selected contractor facility.

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (R1)

RECEIVED
4 MAY 1978

1. Project Number: 1904 (ARRCOM) 2. PA: 4250 3. COST: $439K

4. Title: One Piece Skin for BLU-96/B

5. FACILITY/CONTRACTOR: Naval Weapons Center, China Lake/Honeywell, Inc.

6. SUMMARY: a. Problem:

The BLU-96/B skin should be a one piece skin to eliminate leak paths and reduce machining and welding time.

b. Solution: Develop a tool suitable for fabricating 10 foot long internally grooved skins.

c. End Product: A tool for fabricating 10 foot long grooved skins.

d. Implementation: Acceptance testing and implementation will be at contractors plant.

e. Environmental Impact Statement: The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

f. There are no OSHA requirements in this project.

7. ECONOMICS: a. Total project cost is estimated to be $439K to be funded as follows:

FY80 = $431K
FY81 = 8K

These costs include installation and implementation at the selected contractor facility.

EXI T P-16 (Part I)
815?

DUPLICATE

GN

DATE: 1 JUNE 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804184 (ARRCOM) 2. PA: 4250 3. Cost: $425

4. Title: MMT: Form Sabot Seg to Net Shape on APFSDS Ammo

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Current methods of making sabot segments is to use extruded bar segments, face off the side to 120^{o} angle, clamp three segments together and machine approximately 2/3 of the starting material away to arrive at a finished sabot. This represents a material waste and extensive machining time, both of which result in high unit costs. In previous PEP efforts to forge sabot segments problems were encountered in maintaining dimensions following forging and subsequent heat testing due to relaxation of stresses induced during heat treating.

b. The solution: Continue PEP effort on forging to net shape, solution heat treat, dimensionally analyze after quenching, design straightening dies and cold straighten to eliminate distortion. The part will then be aged and again dimensionally analyzed to determine if any additional distortion occurred. Parts will then be finish machined to determine if any movement occurs during machining.

c. The end products of this project are: The end products will be a manufacturing process to form the sabot segments of APFSDS projectiles in lieu of machining from rod. This will result in a 70% savings in aluminum and an estimated total reduction in unit cost of $5.75.

d. The implementation: Additional equipment in the amount of $2,750,000. will be required to implement this process.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), date 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: There was no preceding Government sponsored R&D effort related to this project. This effort will not be duplicated on the 120mm RDT&E Program. The total cost of this project will be $425 as follows: FY80 - $425. No additional Government costs should be required to implement the PEM project results.

5804184

DUPLICATE GN

EX. :T P-16 (Part I)
8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804187 (ARRCOM) 2. PA: 4250 3. Cost: $325

4. Title: MMT: Forming Boom of HEAT Ammo by Upset Forging

5. Facility/Contractor: ARRADCOM, Dover, NJ/contractors to be selected

6. Summary:

a. The problem: The boom (tail fin extension) on HEAT rounds has a hub on one end for threading to the body which is approximately 2.5 inches greater in diameter than the remainder of boom. Currently this is machined from large diameter rod at a considerable loss in material. In addressing upset forging, the problem is expanding the minor diameter of the starting bar to approximately 2.5 times in size to form the hub end (note sketch) without damaging the integrity of the part.

b. The hub end will be expanded in two forming operations on a heading machince. The first operation will expand the end approximately 1.5 times the starting bar diameter. The second operation will expand to the required diamter while at the same time forming the cavity.

c. The end products of this project are: The end product will be an optimized manufacturing process for the boom resulting in a cost savings by starting with less aluminum alloy material.

d. The implementation: No changes to the technical data package is required. Additional equipment required to institute this process is estimated to cost $1,500,000.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment dated 1 April1978 are available. No significant environment impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: There was no preceding Government sponsored R&D effort related to this project. The total cost of this project will be $325 as follows: FY80 - #325.

An estimated $1,500,000. will be required to implement the PEM project results. Results of an economic analysis indicate a savings of approximately $10.36 per projectile. This effort will not be duplicated with 120MM RDT&E funds.

165

5804187

EXHIBIT P-16 (Part I)
81

DUPLICATE GN

DATE: 1 J 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804188 (ARRCOM) 2. PA: 4250 3. Cost: $200

4. Title: MMT: Forming Tail Fin for APFSDS Projectile

5. Facility/Contractor: ARRADCOM, Dover, NJ/contractor to be selected.

6. Summary:

a. The problem: The current method of making tail fins is by machining continuous extrusions of the fin geometry to the final configuration. The starting weight of the extrusion is 1.289 lbs. The finished weight of the fin is 0.41 lbs. Thus, 68% scrap is generated. Conventional forging processes are not precise enough for the part to meet the tolerances specified on the applicable drawing. Precision forging methods achieve net shape dimensions but these are distorted during subsequent heat treating. The critical problem is bringing these dimensions back within tolerance following heat treating.

b. The solution: The fin will be formed by precision forging methods followed by solution heat treating. The extent of distortion shall be determined and a die designed to cold straighten the part. The part will then be aged and again dimensionally checked to assure dimensions are within tolerance.

c. The end products of this project are: The end products will be a manufacturing process to form the fin the net shape in lieu of machining continuous extrusions. This will result in a 68% savings in material and a reduction in unit cost of $.74.

d. The implementation: Additional equipment in the amount of $1,500,000 will be required to implement this process.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: There was no preceding Government sponsored R&D effort related to this project. This effort will not be duplicated with 120mm RDT&E Funds. The total cost of this project will be $200 as follows: FY80 - $200.

5804188

EXI. T P-16 (Part I)
8152

DUPLICATE

GN

DATE: 1 Jun. 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804189 (ARRCOM) 2. PA: 4250 3. Cost: $1,490

4. Title: MMT: High Fragmentation Steel Production Process

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Limited uneconomical production of high fragmentation steel projectile metal parts has exposed many problems and the need for investigation into and refinement of production processes and techniques which will reduce unit costs, while yielding the quality products required. Problems include excessive machining required in trepanning projectile hollow boat tails, oversize mults due to forging eccentricity, high energy requirement of the sphereidize anneal of forgings, 2-hit mosing operation requiring an intermediate stress relief, no production method for applying base plate to hollow boat tail projectiles, inability of heat treatments to impart both mechanical properties and the toughness required for drop testing, and lack of an economical technique for testing that toughness. Also, high fragmentation anomalies such as heat-to-heat chemistry, alloy segregation, and material soundness need to have their impact assessed and inspectability determined.

b. The solution: New and improved production processes and techniques will be examined and refined relative to the manufacture of high fragmentation steel projectile metal parts. General areas of study will include reduction of starting mult weight via forge tooling designs, optimization of machining techniques, determination of necessity to spheroidize anneal forgings, feasibility of one-hit hot nosing, evaluation of induction stress relieving nosed bodies, determination of most practical technique for welding base plate, examination of various heat treatments, and evaluation of new fracture toughness test. All projectile metal parts will be processed to their finished state in order to evaluate all fabrication processes and inspectability with investigation of problems encountered and improvements made where possible.

c. The end products of this project are:

(1) Improved and economical processes for manufacture of high fragmentation steel metal parts. Items include 155mm M549, 155mm XM795, 8" XM650, 8" XM711 and 81mm M374A3E1.

(2) Comprehensive data bank on processing high fragmentation steel.

(3) Reliable, economical fracture toughness test for incorporation into TDPs of high fragmentation steel metal parts.

d. The implementation: Existing facilities will require modification in order to process high fragmentation steel. This work will allow those modifications to be done in the most prudent fashion such that end item unit cost will be minimized. Return on investment will accrue throughout the production life of the items.

e. The Environmental Impact Assessment: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Total cost of this project will be $2600 as follows: FY - 80 - $1490, FY81 - $1110. Modification of existing facilities will be required for manufacture of high fragmentation steel metal parts supported by this project. It is anticipated that facility modification costs will be basically the same regardless of whether modifications are based on existing technology or that established as a result of this project. Therefore, no additional costs to implement the results of this project are anticipated.

b. Economic analysis (Inclosure 2) has demonstrated a dramatic reduction in recurring costs via implementation of project results. Also, the production knowledge gained through this study will be of vast benefit when future high fragmentation steel production is undertaken.

c. Performance and implementation of this project will neither have an adverse effect on the environment nor violate safety standards.

EXI T P-16 (Part I)
8152

DUPLICATE

BH

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804190 (ARRCOM) 2. PA: 4250 3. Cost: $384

4. Title: MMT: Molding Rear Seal, 120mm FRG, APFSDS, Projectile.

5. Facility/Contractor: ARRADCOM, Dover, NJ; TECOM, Aberdeen, MD; Flinchbough Products Incorporated, Red Lion, PA

6. Summary:

a. The problem: The 1200mm FRG, and the 105MM XM774 projectiles utilize a rubber-like rear seal to prevent propellant gas flow past the projectile base. The present Technical Data Package (TDP) mandates that the seal be molded in place after assembly of the projectile components. This process requirement does not lend itself to high speed mass production techniques because of excessive manual labor and extremely complex molding processes. The mandated processes also generate an OSHA problem which metal parts plants are not euipped to handle.

b. The solution: This program will examine techniques to attach a separately molded rear seal to the assembled projectile unit without affecting ballistic performance. The plan of attack is to contract for manufacture of the rear seal with an independent molder of rubber products. This will transfer the OSHA problem to a producer equipped to handle it. Various means will be evaluated to attach the molded rear seal to the projectile assembly such that intimate adhesion is attained. Laboratory tests will be conducted to determine the optimum candidate process for qualification firing by TECOM. This project will eliminate an expensive bottleneck in the 120mm and 105mm production lines and will reduce facilities costs in follow-on PEM projects.

c. The end products of this project are: The end products of this project will be an acceptable mass production process for installation of the rear seal on the 120mm and 105mm projectiles and a reduction in the facilities requirement for production of this round.

d. The implementation: The results of this project will be implemented by modification of the T.D.P. of the FRG 120mm and 105mm XM774 APFSDS projectiles.

5804190

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. There are no past Government sponsored efforts as this round was developed in the Federal Republic of Germany. The total cost of this project will be $384 as follows: FY80 - $384

b. This project will result in a per round savings of $1.25 per projectile.

c. The performance of this project will have no adverse effect on the environment or violate any safety standards.

5804190

EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5806738 (ARRCOM) 2. PA: 4250 3. Cost: $350

4. Title: MMT: Ultra-High Speed Metal Removal, Artillery Shell

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801/Contractor to be selected

6. Summary:

a. The problem: Conventional spindle speeds used in the metal removal operations for 155mm projectile metal parts vary from 400 to 500 RPM. Removing metal at these speeds requires large quantities of equipment to accomplish a particular machining operation. As an example, the 155mm M483 rough turn operation requires eight lathes to produce 240 acceptable projectiles per hour. The approximate cost of a lathe with automatic load and unload features, to perform this operation is $150,000 and, therefore, a total cost of $1,200,000 is required for the equipment for this operation.

b. The solution: The solution to this problem is to investigate another technique for high speed metal removal. At the direction of the PM for PBM the means of achieving increased metal removal which will be investigated under this project has been limited to plasma arc assited machining. A significant increase in productivity is expected with plasma arc assisted machining.

c. The end products of this project are: The end product of this MMT project will be the development of a manufacturing method and technology that can be used for machining steel at metal removal rates significantly in excess to those currently practiced with an attendant reduction in production costs.

d. The implementation: After successful completion of the MMT project, to obtain a return on investment, fewer machine tools will be purchased to perform an operation, thus resulting in an equipment cost savings, utilities savings, and labor savings.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

DATE: 1 APRIL ,978

7. Economics:

a. Preceding government sponsored efforts of this project for fiscal year: Prior R&D - NONE, FY79 - $181 Projected costs are as follows: FY80 - $350. Total Project Cost $531.

b. A substantial increase in productivity is anticipated with plasma arc assisted machining.

c. This project will have no adverse effect on the environment.

DUPLICATE

EXHIBIT P-16 (Part 1) DATE: 1 June 1978

8152

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 9 JUN 1978

1. Project No. 6803901 2. PW 3297 3. Cost: $343.2
4. Title: MM&T Manufacture of Fluidic Amplifiers by Cold Forming (2nd Year Follow-On).
5. Facilities/Contractors: Harry Diamond Laboratories, 2800 Powder Mill Road
Adelphi, MD 20783. Contractor: To be selected.

6. Summary

a. Problem: The existing fluidic amplifier manufacturing processes, chemical milling and nickel electroforming, have not been completely successful in solving the problem of low-cost, large-quantity fluidic amplifier fabrication. Both processes require relatively extensive and expensive controls to insure satisfactory yield. Also, there are undercutting and repeatability problems attendent to the chemical milling process and critical cost and availability problems associated with producing electroforming nickel components.

b. Solution: Adapt the existing process of cold forming for less-costly, higher-quantity production of aluminum fluidic systems. The cold forming method will produce fluidic components/systems with greater dimensional repeatability and better surface finish than the above mentioned processes. That the achievement of these goals can be expected is borne out by an R&D effort in FY72-73. Excellent repeatability and performance were obtained in tests of amplifiers prepared by cold forming.

c. End Products: At the completion of this project, a technical report will be generated describing the manufacturing process and methods of application to on-going programs (e.g. tank-gun stabilization). Samples of cold forming dies, other tooling, and bonded fluidic components will also be available.

d. The Implementation: Coordination with the Army's lead laboratory for tank-gun stabilization(ARRADCOM) and the program manager of the applicable weapon system (e.g. M60) will be necessary, assuming successful completion, to effect transfer of the production technology and to insure payoff on the funds invested.

7. Economics:

a. Previous PEM funds which will have been expended in FY78 amount to $290k. Additional government costs would be in the development and implementation of specific fluidic systems. One specific system is the fluidic tank-gun stabilization system that, when fully developed to an end-item stage, will be cost-and performance competitive with the existing M60 add-on stabilization kit. In FY75, an informal assessment of possible future savings if a fluidic stabilization kit were employed on M60 tanks indicated that as much as $3.0k (FY75 dollars) per kit could be realized. For a typical retrofit quantity of 2000 units, the cost savings would therefore be as high as $6M--or considerably more for kits installed in large-scale tank production.

b. An economic analysis has determined that the savings resulting from cold-forming as compared to nickel-electroform production for a quantity of 10,000 kits could amount to 722K (see Incl. 2).

c. The environmental consequences of this project have been assessed, and the approved EIA, dated 6 Apr 77 is available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

Project No: 6803901 (ARRCOM)

DUPLICATE

EXHIBIT P-16 (Part 1)
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED JUN 1978

Date: 1 Jun 78

1. Project No.: 6807605 (ARRCOM) 2. PW,A 3297 3. Cost (Thous): $130

4. Project Title: MM&T: Chemically Bonded Sand for Close Tolerance Casting

5. Facility/Contractor: Rock Island Arsenal, Rock Island, Illinois 61299, and contractor(s) to be selected.

6. Summary:

a. Problem. Rock Island Arsenal's foundry currently uses green sand molds and baked oil sand cores. These methods of molding and core making are costly, energy wasteful, and unsuitable for holding close tolerances compared to new chemically bonded sand systems. Also, the present system's inability to hold close tolerances makes subsequent machining operations, particularly Numerical Control, time consuming and costly.

b. Solution. This project funding program will install a chemically bonded sand core making and molding system at RIA. In the chemically bonded sand system, a catalyst is added to the sand for both the cores and molds. This causes air hardening, thereby eliminating the requirement to bake the cores and creating more rigid molds. The rigid molds are easier to handle and prevent the cores from shifting under the weight of the molten metal, thereby allowing closer tolerances to be held. The FY79 project of the funding program will install a small sand mixer and conveyor system, rework several small patterns, and prove out the system for cores and small molds. This follow-on FY80 project combined with equipment procured through an FY80 PIF project will install and prove out a system suitable for larger molds.

c. End Products. The end products of this project funding program plus the PIF procured equipment will be an operational chemically bonded sand system for production use at RIA and a final report detailing the operating parameters of the system.

d. Implementation. After completion of this funding program combined with the PIF procured equipment, no additional implementation will be required to obtain the benefits from the program.

e. Environmental Assessment. The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written environmental impact assessment.

7. Economics:

a. There have been no preceding Government R&D efforts. PEM funds required for this project funding program are $127,000 for the FY79 project and $130,000 for this follow-on FY80 project. Additionally $380,000 for equipment is included in the FY80 RIA PSR Project No. 6806966.

b. Benefits to the Government will include a reduction in manufacturing costs at RIA accruing primarily from reductions in the number of molders and core makers required. Benefits will also include reductions in energy consumption, material consumption, and subsequent machining operations. Results of the economic analysis (Incl 1) indicate a Savings/Investment Ratio (S/I) of 4.75 and a Rate of Return on Investment (ROI) of 69%.

EXHIBIT P-16 (Part I) DATE: 1 June 1978

8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No.: 6807730 (ARRCOM) 2. PA: 3297 3. Cost: $148.0
4. Title: MMT: Manufacture of Split Ring Breech Seals
5. Facility/Contractor: Watervliet Arsenal, Watervliet New York/Benet Weapons Lab. Watervliet NY and undetermined contractors.
6. Summary:

a. The Problem: The split ring is a precisely manufactured complex item which provides a gas seal. The present manufacturing methods have been used since the development of the split ring. These methods are out dated and costly, requiring considerable hand finishing by highly skilled personnel. The rejection rate for this item is high. Furthermore, it is a high replacement item during the life of a weapon.

b. The Solution: Automated and improved procedures will be adopted which will minimize hand finishing operations and negate the need of highly skilled operators and thereby reduce the cost. In FY79 new methods will be developed for slitting the ring requiring less stock removal, and significantly reducing the subsequent operations. In the 2nd yr. equipment will be purchased, installed and tested.

c. End Product: The end products will consist of new automated manufacturing equipment, tooling, and techniques to manufacture split rings at a reduced cost. In addition, designs of machinery, operating conditions, i.e., speeds, feeds, tooling and all the necessary information to implement the newly developed techniques will be compiled into a complete package.

d. Implementation: Data and designs will be turned over to the manufacturing organization for introduction into production, together with the equipment.

e. Environmental Considerations: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program.

Preceding R&D	Prior FY 79	FY80	Implementation
$0	$137.0	$448.0	$0

(1) Quantifiable: The economic analysis of this project reveals production savings of $1108000. and mobilization savings of $3090000 during economic life. More important than cost savings is the assurance of a reliable, acceptable product. Close tolerances and close sliding fits (to seal the breech pressures) requiring hand benching, will be eliminated.

(2) Non-Quantifiable. It is the object of this project to perfect up to date automated machinery, tooling and modern techniques to manufacture split rings to design specifications with little or no rejection. It should be noted that split rings cannot be made in PEP lines at this time, since the present procedures require highly skilled personnel. The proposed solution would remedy this undesirable situation.

DUPLICATE

EXHIBIT P-16 (Part I) DATE: 1 June 1978

8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6807917 (ARRCOM) 2. PA: 3297 3. Cost: $181.
4. Title: MM&T: Application of Bore Broaching to Mid-Caliber Cannon.
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./ Benet Weapons Lab. Watervliet, N.Y. and undetermined contractors.
6. Summary:

a. The problem: The problem involves the high cost of finishing the bore configuration after boring. Reduction of this cost is necessary. A bore broaching process had been developed for small caliber weapons but the equipment and tooling used on these weapons were adapted to an existing machine. In most cases the designs were dictated by the machine upon which it was mounted rather than having the freedom of design that would offer the best operating advantages.

b. The solution. The process of bore broaching has been proven on small gun tubes. This process can be used for mid-caliber bores. However, the total system has to be reviewed and a machine and tooling package must be integrated into a complete, efficient boring and rifling operation in order to gain maximum benefit from the bore broaching process.

c. The end product. This year's effort will result in the complete tool package and specification for a compatible machine.

d. Implementation. The equipment obtained as a result of this project will be set up in a production shop. There will be no further implementation costs.

e. Environmental considerations. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	FY81	Implementation	FY 83 $
$0	$75.0	$181.	$295.	$20	

b. Benefits:

(1) Quantifiable. A savings of 4 hours per component will be realized through the implementation of bore broaching with rifling.

(2) Non Quantifiable: The objective of this project is to develop a bore finishing machine and tool system. The complete system will replace the honing operation and will combine the bore finishing with the rifling operation thereby reducing material handling.

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

EXHIBIT P-16 (Part I) RCS CSCRD-165 (R1) DATE: 1 June 1978

8152

1. Project Number: 6807920 (ARRCOM) 2. PA: 3297 3. Cost: $233.0
4. Title: MM&T: Conservation of Critical Materials for Gun Tubes
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab and undetermined contractor.
6. Summary:

a. The Problem. Through an evolutionary process, the manufacturers of gun tubes have developed an alloy steel which has proven satisfactory for tube forgings. In this steel, however, the major alloying elements must be purchased outside the U.S. and some are becoming relatively short in supply. For example, 95% of the world's chrome ore reserves are located in Rhodesia and South Africa and our continued reliance on these politically unstable countries is not wise. There is a need for materials and processes which use less of these critical elements.

b. The Solution. Alloy steel variations have been developed which might solve this problem. For instance, replacing chromium with molybdenum which is available in this country (50% of the world's reserves). However, molybdenum does not harden steel as well as chromium, necessitating improved heat treating techniques. With this project, the necessary processing modifications to allow the use of steels with lower critical alloys, will be generated.

c. The End Products. The end product will be processing parameters to allow the use of alloy steels with less critical alloying material.

d. Implementation. The results will be applied to specifications used to procure material for the rotary forge. They will also be used in the production of material and forgings by outside vendors.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	Implementation
$0	$0	$233.0	$0

b. Benefits:

(1) Quantifiable: It is estimated that the cost of materials can be reduced by $.05-.10 per pound.

(2) Non-Quantifiable: The implementation of this project will reduce reliance on foreign sources for critical materials. This is especially important since it is predicted that the use of chromium for stainless steels will increase in the future, while supplies decrease. Thus, decreasing reliance on the critical alloys will insure a steady supply of material for tubes, as well as decreasing their cost.

c. Environmental Considerations: The environmental consequences of this action have been assessed. No significant impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

EXHIBIT P-16 (Part I)

8152

DATE June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6807925 (ARRCOM) 2. PA: 3297 3. Cost: $110.0

4. Title: MMT: Bore Evacuator Boring

5. Facilities/Contractor: Watervliet Arsenal, Watervliet, N.Y., Benet Weapons Lab, Watervliet, N.Y. and undetermined contractor.

6. Summary:

a. The Problem: The chamber is a weldment and the bores must have a coincident centerline. These bores are machined on different setups and location of the component for the second end operation poses positioning problems. The complexity of the bore configuration presents an area where tool development can result in reduction of operational time.

b. The Solution: A special purpose machine and tooling package providing a head for each end of the evacuator chamber can be developed to produce both bores simultaneously. If both surfaces were produced from the same setup, orientation of the centerlines would be automatically assured. A form mill similar to a hob is envisioned as the tooling so that when the bore diameter is complete, all other features of the bore will also meet their dimensional requirements.

FY80 funding will provide for setting design parameters and preparation of specifications.

FY81 funding will provide for equipment acquisition, testing, and final technical report.

c. End Product: A special purpose machine will be designed, procured and tested. The end product will be a complete tooling package for the 105mm M68 bore evacuator and a machine capable of accepting tooling for all in-line bore chambers.

d. Implementation: The equipment obtained as a result of this project will be set up in a production shop. The machine will be capable of handling a variety of chambers; however, the tooling package will be developed for one specific chamber. Due to the differences in diameter and fastening techniques, an additional tool package will be required at a cost of $10,000 for the 155mm M185 bore evacuator.

e. Environmental Considerations: The environmental consequences of this action has been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environment Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	FY81	Implementation (FY83)
$0	$0	$110.0	$245.0	$13.1

b. Benefits:

(1) Quantifiable: At the completion of the three year effort, the techniques developed will be applicable to those bore evacuator chambers cited in Item 8. An average savings of $35. per component will be realized after implementation of this project on the 105mm M68 Evacuator.

(2) Non-Quantifiable: A reduction in machining time as a result of boring simultaneously both ends of the bore evacuator chamber.

EXHIBIT P-16 (Part I)
8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No: 6807926 (ARRCOM) 2. PA 3297 3. COST: $214.0

4. Title: MM&T: Hot Isostatic Pressing (HIP) of Large Ordnance Components

5. Facility/Contractor: Watervliet Arsenal, Benet Weapons Laboratory, Watervliet, New York and undesignated contractors.

6. Summary:

a. The Problem. Producing the complex final configuration required for step thread type breech blocks has continually been a manufacturing problem. Many hours are required to machine the breech block from the as received rough forging to the finished part. During this machining, 25% or more of the rough forging becomes chips. With the high cost of alloy steels, this becomes very costly in terms of material and labor. Rough formed breech blocks should be produced closer to the final net configuration.

b. The solution. By using HIP (Hot Isostatic Pressing) it is possible to fabricate breech blocks closer to the final shape than the currently used forging. This method of forming consists of powdered metal subjected to high pressures and high temperatures to form a full density part. This method has been in use since the 1950's but for many years, the equipment required discouraged production use of the process. The improvements in pressure vessel design and the improved furnace designs have now brought the HIP process to a very practical production process.

c. The End Products. The end product of this effort will be a complete production technique capable of producing a step thread type breech block using the HIP process. Breechblocks will be produced.

d. Implementation. There will be no additional cost for implementation of this project.

e. Environmental Considerations. The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Therefore, there is no need to prepare a written Environmental Impact Assessment.

7. Economics

a. Funding Program:

Preceding R&D	Prior FY	FY80	FY81	FY82	IMPLEMENTATION
$0	$0	$214.0	$0	$242.0	$0

b. Benefits:

(1) Quantifiable: On a step type breech block, the size of the 175mm M113, the rough forging for this part weighs 275 pounds while the part only weighs 202 pounds in the near net configuration. With the elimination of 75 pounds of total material used, a high percentage of alloy agents is also saved. A further savings is obviously the reduction in labor for removal of this excess material. A minimum of 15 hrs. labor per component could be saved resulting in a savings of approximately $432 per breech block.

(2) Non-Quantifiable: The implementation of this program will result in savings of alloying elements, some of which are very expensive and short in supply, viz., chromium. This action will conserve these resources and also the energy spent in producing them and the energy necessary to machine the pieces.

EXHIBIT P-16 (Part I) DATE: 1 June 19[illegible]

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6807927 (ARRCOM) 2. PA 3297 3. Cost: $85.0
4. Title: Generation of Base Machining Surfaces.
5. Facilities/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab, Watervliet N.[illegible] and undetermined contractor
6. Summary:

a. The Problem. In order to obtain a distribution of stock on a rough cast component, it is currently necessary to "draw" the finished component on the material using height gage and layout templates. This is done on a layout table from which the part moves to a machine for similar setup to establish the base cut to the layout line. Since the part has to be setup twice to the exact position, there is obviously a redundancy of effort.

b. The Solution. Using preset layout techniques, such as optical shadow layout templates, the component can be positioned directly on the machine to establish the first cut eliminating the initial layout operation.

c. The End Product. The end product of this project will be a process and layout equipment to establish stock distribution on rough forgings at the machine site.

d. Implementation. The layout equipment will be installed on a production machine and instructions on its use will allow immediate implementation. Layout materials will be provided for 2 style breech rings.

e. Environmental Considerations. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program.

Preceding R&D	Prior FY	FY80	FY81	Implementation FY 85 $
$0	$0	$85.0	$135.0	$39

b. Benefits.

(1) Quantifiable: This project, addressed to large castings and forgings, provides for a ten year discounted savings of $241,748 for present production and $494,297 for mobilization.

(2) Non-Quantifiable: The objective of this project is to develop a technique to combine the setup of this first cut with stock distribution procedures to eliminate redundant setups.

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6807933 (ARRCOM) 2. PA: 3297 3. Cost: $65
4. Title: MMT: Central Coolant Systems
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./ Benet Weapons Lab, Watervliet N.Y. and undetermined contractor.
6. Summary:

a. The Problem. Currently a variety of machine tools use identical coolants. These machines are used intermittently and the lack of agitation allows a stagnation and, consequently, a bacterial build up. It is difficult to perform a proper coolant maintenance program at a great number of sites.

b. The Solution. Examine and compare the use of central coolant distribution systems against the individual machine sump system. Generally central coolant systems can reduce coolant consumption by maintaining proper concentrations, bacteria and ph control. Some of the machines in the system will be in use regularly so that aeration is more likely in central systems. Finally, a single site reduces the cost and improves the likelihood of proper coolant maintenance.

c. The End Product. This project will result in a comprehensive recommendation of a central coolant system including the volume required, pumping specifications and the number and mix of equipment serviceable by the system.

d. Implementation: The project implementation will be effected under MOD 6828013 Central Recycling of IPE Coolant FY 82 - $235

e. Environmental Considerations. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

	Preceding R&D	Prior FY	FY80	Implementation FY 82
	$0	$0	$65.0	$235 (MOD)

b. Benefits:

(1) Quantifiable: Cost savings from this project are dependent upon the extent of application; however, reductions of 50% in the use of critical materials is anticipated.

(2) Non-Quantifiable: Central coolant systems reduce coolant consumption by maintaining proper concentrations, bacteria, and PH control. Single site improves proper aeration and proper coolant maintenance.

EXH. P-16 (Part I)
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DUPLICATE

FA

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6807940 (ARRCOM) 2. PW: 3297 3. Cost: $120

4. Title: MMT: Synergistic Platings with Infused Lubricants

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: The development of rapid fire weapons has resulted in increased wear to many of the moving parts. Present dry film lubricants as well as greases or oils tend to wear off with use and, therefore, require frequent reapplication or reservoirs. Such maintenance or built-in reservoir systems are not practical solutions to many weapon systems:

b. The solution: The establishment of a synergistic plating process can provide coating systems with improved resistance to corrosion, reduced friction and permanent lubricity. Such a process is desirable but cannot be applied to weapon systems until the Army establishes a manufacturing process which can be used at Government installations or supplied to contractors. These platings are electrodeposited and electroless metallic coatings (generally nickel or chrome-nickel alloys) characterized with extreme porosity. The porous condition enables the subsequent infusion of lubricants (fluorocarbon polymers or molybdenum disulfide) by a controlled heat-treatment cycle. These coatings would improve friction resistance and increasse the wear life of many moving parts in rapid fire weapon systems. This project would immediately replace silver plating, a costly short ? supply material with inadequate wear resistance, on rotor tracks of the M61A1, M168 and other 20-30MM cannons. Other applications include the bolt body and barrel extension on the M85 and M219 mahcine guns, the M16 bolt body and the M60 operating rod and bolt. A two-year effort is expected to accomplish the necessary task. The FY80 effort will examine the application and characteristics of porous nickel and alloy electrodeposits to various types of ferrous surfaces. These deposits will then be subjected to controlled infusion of lubricants such as fluoro-carbon polymers or molybdeum disulfide. The FY81 effort will continue the evaluation of the synergistic process. The processes which yield the best results will be applied to the bolt and bolt carrier systems of small arms and a manufacturing process description will be prepared.

c. The end products of this project are:

(1) An engineering report containing test data, evaluation and recommedations for implementation.

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(2) A manufacturing description applicable for use in production and as a reference for design and quality control personnel.

d. The implementation: Technology implementation will involve transfer of methodology established in the project to Army, other DOD and industrial facilities through specification modifications, technical consultations, and assistance.

e. Environmental Impact Assessment: The environmental consequences of this action have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $240K as follows: FY80-$120K; FY81-$120. Implementation to production facilities will require an additional $70,000 in FY82 (PEM, Prod. Support, PIF).

b. The benefits resulting from this project will be:

(1) An economic analysis (Inclosure 2) shows a cost savings of $604,100 over a 10-year period and a ROI of 38% based only on a singular weapon system. Further cost savings can be realized when the new process is applied to other weapon systems.

(2) Elimination of costly bearing materials as silver or gold which are in short supply.

(3) Elimination of frequent maintenance and application of spray lubricants.

(4) Improved friction and wear resistance of weapon components will reduce spare part inventory and results in significant cost reductions.

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DUPLICATE

EXHIBIT P-16 (Part I)
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

Date: 1 Jun 78

1. Project No.: 6807948 (ARRCOM) 2. PW,A 3297 3. Cost (Thous): $158
4. Project Title: MM&T: Establish Cutting Fluid Control System
5. Facility/Contractor: Rock Island Arsenal, Rock Island, Illinois 61299
6. Summary:

a. Problem. Cutting fluids (CF's) are procured on the basis of trial-and-error procedures. A CF is purchased and tried for a certain machine or group of machines. If it seems to perform satisfactorily, it is then used for that machine grouping. This is a non-quantative empirical approach and often leads to the selection of CF's which do not give the lowest life cycle costs. Optimum procedures for maintaining and replacing CF's are often not followed because the cost impact of not following them is unknown.

b. Solution. This program will identify test methodologies for determining life cycle costs of CF's for various types of machine tools. Systematic testing of CF's will be initiated to determine the most economical CF's to be used based upon initial cost, cutting costs, storage and service life costs, and disposal costs subject to meeting health and safety requirements. SOP's and process specifications will be generated so that Rock Island Arsenal will gain the maximum utility of the CF's procured. As a result of this project, CF's will be procured based upon life cycle performance costs. This project supports the major recommendation of the CF panel of the DOD/Industry Chip Removal Conference which stated that the procurement of CF's should be based upon performance, i.e., cost/piece machined.

c. End Products. This project will provide a completely integrated control system for the procurement of CF's using identifiable performance criteria rather than purely empirical determinations.

d. Implementation. Findings of machine/tool vs cutting fluid interactions using instrumented machining tests will be implemented at the Rock Island Arsenal. The findings (including laboratory evaluations of cutting fluids for conformance to health and safety standards) will be fully utilized to assure that a cost effective control system for machine tool/CF is acquired. SOP's and process specifications will be generated, as applicable, during the course of the program to help formulate the overall control system.

e. Environmental Assessment. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. There have been no preceding Government R&D efforts of this scope. The project cost is $150,000 for FY79; $158,000 for FY80; and $164,000 for FY81.

b. An Economic Analysis (Incl 1) has been prepared. Quantifiable benefits are estimated at $2,700,000 over a 10-year period. The average yearly benefit of $270,000 coupled with the estimated $10,000 savings in cost of cutting fluids is based on estimates of improvements in machining through cost effective control of procurement, stocking, distribution, testing, application, maintenance, and disposal of cutting fluids.

DUPLICATE

EXHIBIT P-16 (Part I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE. 1 June 1978
8152 RCS CSCRD-165 (R1)

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9 JUN 1978

1. PROJECT NO. 6807949 (ARRCOM) 2. PW 3297 (NC) 3. COST. $155

4. TITLE. MMT: Application of Group Technology to RIA Mfg. (CAM related)

5. FACILITY/CONTRACTOR. Rock Island Arsenal, Rock Island, Illinois, and contractor(s) to be selected.

6. SUMMARY.

a. The problem. Current developments in the areas of classification and coding systems and group technology as applied to discrete parts manufacturing indicate substantial savings can be achieved by utilizing techniques which exploit the underlying sameness of parts to bring many of the benefits of mass production to small lot production. Reductions in manufacturing costs can be achieved from reductions in set-up time, tool inventory, and work-in process, and improvements in process planning, capital equipment selection, and cost estimating. These techniques are not currently being utilized by Rock Island Arsenal (RIA).

b. The solution. This funding program will bring the benefits made possible by classifying and coding production parts, and utilizing group technology, to RIA's manufacturing. In the FY79 project, the coding system procured by Picatinny Arsenal will be adapted to and installed on RIA manufactured parts, a computer terminal with access to the coding system and production data will be installed, and adaptation of application software initiated. The coding system and software procured by Picatinny Arsenal under a previous MM&T project is available to RIA at no cost. In this follow-on FY80 project, adaptation of application software will be completed and test applications performed. Based on the test applications, procedures for utilizing the system will be documented and the cost savings detailed.

c. The end products. The end products of this project funding program will be a classification and coding system installed on RIA's manufactured parts and the application software necessary to utilize this system to reduce total manufacturing cost.

d. The implementation. No additional implementation will be required to obtain the benefits from this project funding program.

e. The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written environmental impact assessment.

7. ECONOMICS.

a. Funds required for this project funding program are $127,000 for the FY79 project and $155,000 for this follow-on FY80 project.

b. Benefits to the government will include reductions in manufacturing costs at Rock Island Arsenal accruing from reductions in tool inventory, set-up time, and work in process, and improvements in process planning, capital equipment selection, and cost estimating. Results of the economic analysis (Incl 1) indicate a Savings/Investment Ratio (S/I) of 13.7 and a Rate of Return on Investment (ROI) of 100%.

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DUPLICATE

EXHIBIT P-16 (Part I)
8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808001 (ARRCOM) 2. PW: 3297 3. Cost: $130

4. Title: MMT: Rapid Flow Plating of Small Caliber Gun Tubes

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected.

6. Summary:

a. The problem: Conventional chromium plating of gun tubes is extremely inefficient; requiring long process times and requiring excessive electrical and heat energy consumption. Small caliber gun tubes whose lengths are beyond five feet usually require special deep plating tanks thus involving deep pits, high bay and crane facilities as well as large consumption of bath solutions.

b. The solution: Rapid chromium plating of ID small caliber gun tube surfaces can be accomplished with high current densities under high solution flow conditions. Anticipated increases in deposition rates are 20 to 30 times that for conventional chromium plating. Higher efficiencies (300% increase in current efficiency and 40% reduction in heat dissipation) can be obtained with this method. This project will essentially implement the process established under PN 6777213 and 6797213 for large caliber tubes to the small caliber gun barrels. The FY80 effort will design and evaluate stationary anodes for rapid plating of small caliber gun tubes. Both vertical and horizontal modes of tube-anode position during plating will be examined. Evaluation of anode characteristics (material, configuration, taper) and various flow rates and current densities will be accomplished. The FY81 effort will establish and implement prototype production plating processing of gun tubes in the range from 5.56mm to 30mm.

c. The end products of this project are:

(1) An engineering report containing data, process procedures and recommendations for production implementation.

(2) A pilot plant for processing small caliber gun tubes.

(3) Recommendations for design and specification changes when this process is implemented.

d. The implementation: This project comprises the implementation phase to provide a production process capability for rapid flow plating of small caliber gun tubes.

e. The Environmental Impact Assessment: The environmental consequences of this action have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $270 as follows: FY80 - $130, FY81 - $140.

b. The benefits resulting from this project will be:

(1) The establishment of the process will result in significant reductions in processing time and cost for chromium plating small caliber gun tubes.

(2) The projected ten-year discounted savings are $1,438,000 and the computed ROI is 82%.

(3) Greater savings are anticipated for other small caliber weapon systems and components other than gun tubes.

(4) Less exposure to the hazardous hexavalent chromium by the operation is anticipated because the new process will be a closed system.

(5) Provide a readiness capability for mass producing gun tubes without resorting to massive reestablishment of large plating facilities in the event of a military emergency.

DUPLICATE

6808024

EXHIBIT P-16 (Part I)
DATE: 1 June 1978

8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808024 2. PA: 3297 3. Cost: $321
4. Project Title: MM&T: High Speed Abrasive Belt Grinding
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab. Watervliet, N.Y. and undetermined contractor
6. Summary:

a. The Problem: The hoop zones on the 8" M201 are currently ground to a 125 RMS surface finish. The reason this is ground is to eliminate taper created by normal tool wear when turning this large area. This is not an efficient method of producing a straight diameter. Improved tool life could respond to the problem but attempts in this area have been unproductive.

b. The Solution: Recent advancements in abrasive belt machining technology offers the solution. High metal removal rates and good size control can now be maintained with abrasive belts. They offer wide cutting patterns and can be used as a high volume production capability.

c. The end product: The end product of this program will be a new machine with a capacity to drive a wide abrasive belt for metal removal on gun tube hoop zones.

d. Implementation: The equipment obtained will be transferred to the Operations Directorate and user personnel will be trained in its use.

e. Environmental Considerations: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	FY81	Implementation
$0	$0	$321	$121	$0

b. Benefits:

(1) Quantifiable: A savings of 3.20 hours will be realized upon successful application of this process to 8" M201 cannon.

(2) Non-Quantifiable: Because this is a new machine process, the objective of this project is to introduce the technology to the Arsenal. Its uses will not be limited to those described herein.

DUPLICATE

EXHIBIT P-16 (Part I) DATE: 1 June 1978
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: 6808026 (ARRCOM) 2. PA: 3297 3. Cost: $141

4. Title: (MM&T) Application of Synthetic Quenchants to Gun Tubes and Heavy Weapon Components

5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab and unknown contractor(s).

6. Summary:

a. The Problem: Quenching mediums for large alloy steel components consist primarily of water and oil. Often these quenchants are not satisfactory from both the thermal phenomena and the safety standpoint. As a result, problems such as incomplete transformation, cracking, distortion, residual stress, occasional fires and noxious fumes frequently occur. Current manufacturing technology has not significantly alleviated this problem.

b. The Solution: Recently, polymeric materials have become available that are water soluble and favorably influence the heat transfer properties of *that quenching medium. These* additions alter the quench power of the bath and allow the heat treater to obtain a range of cooling rates while eliminating the hazards associated with oil quenching.

c. End Product: The end product will be a comprehensive technique to quench components, generally requiring oil, in water based synthetic quenchants. Prototype parts will be available for testing and service.

d. Implementation: There will be no additional cost for implementation of this project.

e. Environmental Impact Statement: The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, an Environmental Impact Statement (EIS) is not required.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	Implementation	Total
$0	$0	$141	$0	$141

b. Benefits:

(1) Quantifiable: The application of synthetic quenchants to gun tube components will result in a reduction of rejections due to the variety of heat treatment related problems mentioned in 6(a). The net result is a substantial savings based on the items listed in Para8. The economic analysis of this project reveals production savings of $313,000 and mobilization savings of $2,952,155 during economic life.

(2) Non-Quantifiable: The use of synthetic water base quenchants rather than oil will have a two-fold benefit. First, the nuisance and safety hazards of oil quenching will be eliminated and second, a petroleum product will be conserved.

AD-A067 887 ARMY INDUSTRIAL BASE ENGINEERING ACTIVITY ROCK ISLAND IL F/G 13/8
MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR FISCAL YEAR 19--ETC(U)
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EXHIBIT P-16 (Part 1)
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

DATE: 1 Jun 78

1. Project No.: 6808035 (ARRCOM) 2. PW,A 3297 3.6 Cost (Thous): $140

4. Project Title: MM&T: Coating Tube Support Sleeves with Bearing Materials

5. Facility/Contractor: Rock Island Arsenal, Rock Island, Illinois 61299

6. Summary:

a. Problem. Electric Arc Metallizing (currently used) and Flame Spraying (formerly used) methods to coat tube support sleeves with bearing materials are inadequate. The coatings are porous and exhibit poor adhesion (bond strengths usually less than 1 ksi) to the substrate. Rejection rates are quite high and considerable rework must be accomplished prior to field use. Consequently, low life cycle costs are not realized.

b. Solution. Coating methods such as Gas Metal Arc Welding (GMAW) and induction brazing will provide bushings with little or no porosity and much better adhesion to the substrate. The GMAW process yields bond strengths approaching the yield strength of aluminum bronze (25 ksi). Brazed coatings would have bond strengths equivalent to the strengths of the brazing alloy used. Bearing surfaces applied by brazing and GMAW methods will have lower rejection and rework rates than those previously used for production. A bushing life time of greater than 2000 cycles during field use is expected.

c. End Products. A final report will document the results of project work including test and evaluation of all test bushings. The end product will be an established manufacturing method wherein manufacturing descriptions in the form of SOP's will be used for implementation.

d. Implementation. Technology implementation will involve transfer of methodology and equipment established in the project to production personnel through SOP's, technical consultation and assistance.

e. Environmental Assessment. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. There have been no preceding Government R&D efforts of this scope. The project cost is $140,000 for FY80; $200,000 for FY81. No other funds are required to initiate production.

b. An Economic Analysis (Incl 1) has been prepared. Quantifiable benefits are estimated at $8,910,000 over a ten year period. The average yearly benefit of $891,000 is based on a doubled life of the bushings on the Support Sleeve and a lower reprocessing rate in production.

DUPLICATE

EXHIBIT P-16 (Part I) DATE: 1 June 1978
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808043 (ARRCOM) 2. PA: 3297 3. Cost: $160.0
4. Title: Improved Machining Procedures for Dovetails
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y., Benet Weapons Lab, Watervliet, N.Y. and undetermined contractor.
6. Summary:

a. The Problem: Recoil slide ways are used in the assembly of large caliber weapons. These ways are secured to the barrel using a dovetail assembly which provides a maximum contact area and high strength. However, in order to obtain the maximum strength, full contact of the mating surfaces is required. Current production methods use a number of milling cuts to obtain the final configuration within the close tolerances specified. Because this has to be accomplished in a series of passes, there is the possibility of mismatching the assembly surfaces. The problem then, is how to machine dovetails accurately and economically

b. The Solution: A method of broaching will be developed to provide the complete dovetail configuration on the tube/hoop assembly. Size control will be built into the tooling eliminating the possibility of operator error. Broaching is a far more efficient operation than milling so improvement will be in quantity as well as quality.

c. The End Product. A broaching machine and the complete tool package will be designed and tested. The end product will be a complete production facility for broaching dovetails in the tube/hoop assembly of 175mm M113/8" M201 cannon.

d. Implementation. The equipment and techniques generated as a result of this project will be installed in the production line.

e. Environmental Considerations. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program

Preceding R&D	Prior FY	FY80	FY81	Implementation
0	0	$160.0	$379.0	$0

b. Benefits.

(1) Quantifiable: At the completion of this two year effort the tooling and equipment developed will reduce manufacturing time by 17 hours or approximately $371. per tube assembly.

(2) Non-Quantifiable: The objective of this project is to develop a system for producing the dovetail configuration in a cost effective way while reducing the possibility of machining error.

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DUPLICATE

EXHIBIT P-16 (Part I) DATE: 1 June 1978

8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 6808045 (ARRCOM) 2. PA: 3297 3. COST: $140
4. Project Title: Improved Tube Straightening
5. Facility/Contractor: Watervliet Arsenal, Watervliet N.Y./ Benet Weapons Lab. Watervliet N.Y. and undetermined contractors.
6. Summary:

a. The Problem: Past MM&T developments have made it possible to reduce the size of the forging used in gun tube manufacture. By reducing steel purchases and inherent metal removal operations, stock distribution, a non machining process, has become a more critical operation in the sense that closer requirements are held on the forging straightness. Stock distribution is accomplished by bending the forging to a straight condition that will provide material for machining both the bore and the outside diameter of the tube. The press previously considered acceptably accurate must now be updated to provide the operator with the capability of monitoring and controlling the press operation to these more precise requirements.

b. The Solution: Various monitoring and control devices could be applied to pressing operations, thus eliminating a considerable source of error in obtaining accurate readings of bend (excursion from centerline), ram force, and stroke. This would increase the efficiency of the experienced operator and decrease the experience required to become proficient.

c. The End Product: A press will be equipped with micro ram control devices and suitable gaging to monitor tube deformation and personnel will be trained in the use of the equipment.

d. Implementation: The system developed will have been installed on a production line press and will have been tested on production tubes. (Equipment specifications for presses will be revised for future acquisition)

e. Environmental Impact: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

	Preceding R&D	Prior FY	FY80
	0	0	$140.0

b. Benefits:

(1) Quantifiable: At the completion of this project the converted press will reduce operational time by .75 hours or about $22 per press. Since tubes are generally pressed at least 3 times, the total impact per tube will be 2.25 hours.

(2) Non Quantifiable: The objective of the project is to develop equipment and procedures that will improve the stock distribution methods used to produce a quality product.

EXHIBIT P-16 (Part I) DATE: 1 June 19[illegible]

8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808047 (ARRCOM) 2. PA: 3297 3. Cost: $90.0
4. Title: MM&T: Pass Thru Steady Rests for Tube Turning
5. Facilities/Contractor: Watervliet Arsenal, Watervliet, N.Y. / Benet Weapons Lab. Waterv[illegible] N.Y. and [illegible] determined contractor.
6. Summary:

a. The Problem: Machining of cannon tubes exerts a transverse force greater than the full length tube can withstand. Dimensional and surface finish requirements are impossible to obtain when the tube is unsupported at its longitudinal center. A roller steady rest currently provides the required support but it also becomes an obstacle to turning the full length of the tube in one setup. Currently in order to turn gun tubes either the lathe must have 2 carriages or 2 separate lathes must be provided and the tube moved from machine to machine. There is no supplier of this type equipment.

b. The Solution: A pass thru rest is needed which will allow the carriage to move from one supported area of the tube to the other without disturbing the setup. The design will be applicable to currently available equipment but will have even greater impact on new equipment acquisitions.

c. The End Product: A universal design of a pass through rest will be designed and fabricated. This unit will be designed to be adaptable to a wide variety of in-place equipment and will be specified so that it can be included in new equipment acquisitions.

c. Implementation. The equipment obtained as a result of this project will be installed on a production machine.

e. Environmental Considerations: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	FY80	FY82	Implementation
$0	$90.0	$187.0	$0

b. Benefits:

(1) Quantifiable: At the completion of this project the equipment developed will be applicable to all gun tube turning operations. A reduction of 4 hours per tube is anticipated.

(2) Non-Quantifiable: The objective of this project is to obtain a design for a pass thru rest that will allow full length turn of tubes in one setup.

6808047

DUPLICATE

EXHIBIT P-16 (Part I)

DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No: 6808050 (ARRCOM)   2. PA: 3297   3. COST: $168

4. Title: (MM&T): Recycling Spent Gun Tubes by ESR Melting

5. Facility/Contractor: Watervliet Arsenal, Watervliet, New York and unspecified contractor.

6. Summary:

a. The Problem: Thousands of spent gun tubes are present in supply depots. As part of a previous Project (6757550), six M68 tubes were produced from ESR remelted 175mm tubes. The problem is to improve the economics and develop processing control to allow the remelting of smaller tubes.

b. The Solution: To resolve the problem, processing parameters for remelting all size tubes will be developed. While not obvious, the ESR process becomes more difficult as the size of the electrode (in this case, a fired out tube) becomes more slender and longer. Thus, work on remelting larger tubes is not directly translatable.

c. The End Products: The end product of the program will be a completely worked out production process for the remelting of used gun tubes. In addition, it is expected that several usable forgings will be manufactured in the course of the program, each forging having a substantial value as a procurement item.

d. The Implementation: Discussions have already been held with the Quality Assurance Directorate so that the remelted tubes may be accepted as bona-fide procurement items.

e. Environmental Impact Statement: The environmental consequences of this action has been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	Implementation
$0	$20*	$168	$0

*Approximately $20K was used from Project $6757550.

b. Benefits:

(1) Quantifiable: The development of an acceptable process for remelting spent gun tubes should save approximately $.15/lb. on an M68 forging. This would amount to a savings of approximately $450.

(2) Non-Quantifiable: The process will also minimize the usage of strategic raw materials by utilizing the alloying elements present in the scrapped tubes. The reuse of gun tubes should also minimize problems with P & S which exist at low levels in the scrap tubes.

DUPLICATE

EXHIBIT P-16 (Part I) DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808105 (ARRCOM) 2. PA: 3297 3. Cost: $87.0
4. Project Title: MM&T: Establish Rough Thread Blanks, 8" M201 Bushing.
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab. Watervliet, N.Y. and undetermined contractor.
6. Summary:

a. The Problem: Single point slotting tools are currently being used to produce the configuration of the 8" M201 bushing step thread blanks. The steps are produced on an inside diameter and are somewhat inaccessible. The cubic volume of metal to be removed is high and the configuration is intricate so we require a new process that will remove the material at an accelerated rate. The mating component also has the same configuration but because the threads are on the outside diameter they are more accessible. Again, the metal volume to be removed is high. A machining process is needed to reduce machining time for both of these components.

b. The Solution: There are a number of possible solutions to this problem. Some are applicable to both components while others are limited to one or the other component. On first glance, multiple slotting tools, an extension of the present method, would increase productivity. Alternate solutions include EDM traveling wire, ECM blanking and a combination of milling and multiple slotting.

c. The End Product: The end product will be a selection of the most advantageous approaches to the problem and execution of that selection in the form of equipment acquisition.

d. Implementation: The equipment obtained will be set up in a production facility and user personnel will be trained in the required operational procedures.

e. Environmental Consideration: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	FY81	Implementation
$0	$0	$87.0	$303.0	$0

b. Benefits:

(1) Quantifiable: When this 2 year project is complete the rough thread blank operation will be reduced from the present 19.9 hours to 10.0 hours for a savings of 9.9 hours per component.

(2) Non-Quantifiable: The objective of this project is to identify and develop a method of establishing rough step thread blanks.

DUPLICATE

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EXHIBIT P-16 (Part 1) DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808106 (ARRCOM) 2. PA: 3297 3. Cost: $58
4. Title: MM&T, Large Caliber Powder Chamber Boring
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab, Watervliet, N.Y. and undetermined contractor.
6. Summary:

a. The Problem: Powder chamber contours are currently bored with a single point tool attached to one end of a bar while the other end is supported by the machine carriage. Chamber depths are often in excess of 3 feet. Tool pressure causes deflection of the bar reducing the accuracy of the boring operation and making it necessary to subsequently semifinish grinding the contour.

b. The Solution: Application of a balance tool system will eliminate the deflection problem thereby improving the accuracy of the bored hole making the rough grinding operation unnecessary. An added benefit is that 2 tools will penetrate the workpiece faster and reduce boring operation time.

c. The end product. The end product of the FY80 effort will be a systems design of a hydraulically actuated, electronically controlled boring technique that will be adaptable to current powder chamber boring equipment.

d. Implementation. After completion of this 3 year effort the equipment developed will be moved into a production facility and user personnel will be trained.

e. Environmental Considerations. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

	Preceding R&D	Prior FY	FY80	FY81	FY82
	$0	$0	$58.0	$157.0	$63.0

b. Benefits:

(1) Quantifiable. An average time saving of 3.5 hours per component will be saved upon completion and implementation of this program.

(2) Non Quantifiable. The objective of this project is the development of a hydraulically powered tool system that can control 2 tools equally and simultaneously balancing tool forces, thereby eliminating the inaccuracies currently caused by boring bar deflection.

EXHIBIT P-16 (Part I) DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808107 (ARRCOM) 2. PA: 3297 3. Cost: $344
4. Title: MM&T: Creep Feed Crush Form Grinding
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./ Benet Weapons Lab, Watervliet, N.Y. and undetermined contractor.
6. Summary:

a. The Problem: Despite recent adaption of NC machining centers, the cost of producing certain intricate straight forms on components remains a bottleneck operation. The availability of these machining centers is limited and most are working at near maximum capacity. Conventional grinding operations have a different limitation in their metal removal capacity when applied to intricate configuration development.

b. The Solution: An FY79 program will successfully demonstrate the adaptability of Creep Feed Grinding and a machine specification will be prepared. Equipment acquisition is now necessary.

c. The End Product: The end product of the FY80 project will be a Creep Feed Crush Form Grinding machine tooled for the production of at least one component.

d. Implementation: After completion of this program, no additional funds will be required for implementation to this component; however, it should be pointed out that this project introduces to Watervliet a completely new machining technique that has broad applications. Application of the process to other components should be pursued.

e. Environmental Considerations: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	FY79	FY80	FY81	Implementation
$0	$82	$344	$72	$0

b. Benefits:

(1) Quantifiable: Cost savings from this project as applied to the 105mm M68 breech ring bracket slot will be 2.00 hours per component and as applied to the 152mm M162 coupling will be 1.8 hours per component.

(2) Non-Quantifiable: The objective of this project is to adapt creep feed crush form abrasive grinding techniques to Watervliet's cannon components.

6808107

DUPLICATE

EXHIBIT P-1t (Part I)

8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No: 6808208 (ARRCOM) 2. PA: 3297 3. COST: $112

4. Title: MMT: Material Handling

5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y., Benet Weapons Lab, Watervliet, N.Y.

6. Summary:

a. The Problem. The movement of gun tubes which are large (12" dia.), long (20 feet), and heavy (2 to 4 tons), through the shops as well as positioning the pieces in machines for metal removal presents a considerable material handling problem. Presently the primary handling of tubes is through large rail-mounted overhead cranes. These provide longitudinal in-bay movement, but not cross-bay movement, and also require floor manpower to rope and position pieces in the machines and on the floor. This manpower is costly and time consuming.

b. The Solution. Positioning equipment will be evaluated (such as Heppenstall tongs), side-mounted fork lifts, mono-rail cross-bay transfers with floor controls, and other material moving equipment will be checked for application to the unique problems and material mix (breech rings, breech blocks, and small as well as large components).

c. The End Products: Recommendations will be made for the purchase of specific types of equipment for specific manufacturing areas. A Technical Report will be written.

d. Implementation: Project results will be made available in the form of specific recommendations for the acquisition of Material handling equipment for the support of the Modernization program at Watervliet Arsenal.

e. Environmental Consideration: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	Implementation
$0	$0	$112	$0

b. Benefits:

(1) Quantifiable: No dollar figures available.

(2) Non-Quantifiable: Through-put product time will be reduced, releasing in storage space, and also resulting in reduced man power requirements per unit of product.

6808208

DUPLICATE

EXHIBIT P-16 (Part I) DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808341 (ARRCOM) 2. PA: 3297 3. Cost: $68
4. Project Title: MM&T: Hollow Cylinder Cut Off Machine
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab. Watervliet, N.Y. and undetermined contractor.
6. Summary:

a. The Problem: Establishing cylinder length is accomplished in one of two ways, it is either parted off in a lathe and faced to length or it is rough sawed and then set up in a lathe for facing to finish length dimension. In either case, the operation requires double measuring, double handling and slow operating procedures. A new approach is required that will allow for establishing exact length and produce acceptable finish and eliminate the redundant operations.

b. The Solution: A new technology is being developed whereby a set of rotating cutters mills the cylinder to exact length leaving a surface finish within that specified for cannon requirements. Currently available machines will not accommodate tube forgings but the technology is applicable.

c. The End Product: The end product of this project will be a tube cutoff machine that will combine a length control capability with an efficient cutoff technique to replace sawing procedures.

d. Implementation: The equipment generated by this project will be installed in a production facility and user personnel will be trained in the proper operating techniques. No additional implementation is required.

e. Environmental Considerations: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	FY81	Implementation
$0	$0	$68	$162	$0

b. Benefits:

(1) Quantifiable: At the completion of this program operational time for establishing tube lengths will be reduced from 1.1 hours to .6 hours for a savings of .5 hours per component.

(2) Non-Quantifiable: The objective of this program is to develop a machine that will adjust tube position to establish overall component length and apply modern cutoff techniques to improve production efficiency.

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EXHIBIT P-16 (Part I) DATE: 1 June 1978

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PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. 6808342 (ARRCOM) 2. PA: 3297 3. Cost: $239
4. Title: MM&T: Keyway Milling Machine
5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Laboratory and undetermined contractor.
6. Summary:

a. The Problem: The 155mm M185 gun tube requires 3 keyways be milled on centerline to close location and tolerances. Currently these keyways are milled in 3 different machines requiring 3 material moves, 3 machine sites and 3 setups. Material handling, floor space, and operational time values are all critical commodities in production areas.

b. The Solution: A special purpose keyway milling machine should be developed to hold the tube on location while all 3 keyways are milled simultaneously. In this way we could assure accuracy of all keyways to the proper centerline location eliminating moving the tube from machine to machine providing a reduced operational time and a saving of *floor space*. *Floor space saving* would accrue from the reduction of required machines and from a reduction in tube storage areas while tubes are awaiting various operations.

c. The End Product: The end product of this project will be a special purpose milling machine. It is intended the design will consider automatic self alignment of keyway positions so while the machine will be designed basically for the 155mm M185 tube, it will also have the capability of producing keyways on centerline location on any size tube within the confines of the base design.

d. Implementation: The equipment obtained will be transferred to Operations Directorate and user personnel will be trained in its use.

e. Environmental Considerations: The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

7. Economics:

a. Funding Program:

	Preceding R&D	Prior FY	FY80	Implementation
	$0	$ 0	$239	$0

b. Benefits:

(1) Quantifiable: At the completion of this project and application of the keyway milling machine, a savings of 4 hours per component will be realized.

(2) Non Quantifiable: The objective of this program is to develop a special purpose milling machine designed to automatically locate gun tube centerlines. The machine will have multiple cutting heads and be capable of simultaneous milling of all keyways.

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MUNITIONS
PROGRAM

FY80 MUNITIONS PROJECTS
08/02/78

PROJECT NUMBER	TITLE	COST
R 80 1019	Process Demonstration-Conversion of Surplus Pentaborane	507
R 80 3142	Production Methods for Low Cost Paper Motor Components	200
R 80 3396	Injection Molding of Low Cost - One Piece Nozzles	180
R 80 3404	Manufacture of Ultrafine Ammonium Perchlorate	160
R 80 3447	Scale-up and Demo of Process for Recovery of Carboranes	375
R 80 3448	Recovery of Diborane in the Manufacture of NHC	250
5 80 1003	Low Cost Molded Packaging for Hybrid Electronics	240
5 80 1296	Manufacturing Technology for CB Filters	400
5 80 1318	Est Chemical Production and Fill Close and Lapt Tech for Project 811 VX-2	479
5 80 1345	Manufacturing Methods and Technology for the Biological Warning System	450
5 80 1348	Super Tropical Bleach	199
5 80 1902	Manufacturing Methods of GEL Fuel for FAE Bombs BLU-95/B and BLU-96/B	263
5 80 1903	Die Cast Tailcone for BLU-96/B	1187
5 80 1904	One Piece Skin for BLU-96/B	439
5 80 4000	Automated M55 Detonator Production Equipment	470
5 80 4007	Evaluation of Acetic Anhydride Recycle	93
5 80 4027	Combined Solvent Recovery/Drying of S-B Propellant	304
5 80 4033	Caustic Recovery from Sodium Nitrate Sludge	151
5 80 4037	Process Improvement for Plastic-bonded Explosives	415
5 80 4048	Dev Methods for Process Anal of RDX/HMX Anhydrous Slurry	375
5 80 4059	NQ Crystallization for Continuous Propellant Lines	783
5 80 4061	Nitroguanidine Process Optimization	467
5 80 4062	Auto Manufacture System for Mortar Increment Containers	1100
5 80 4071	Explosive Dust Hazards in Munitions Plants	250
5 80 4078	Upgrade Safety Readiness and Production of Existing Melt Pour Lines	320
5 80 4084	Opacity/Mass Emission Correlation	110
5 80 4086	Reprocessing Explosive Fines and Drill Scrap	350

FY80 MUNITIONS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
4 80 4137	Automated Loading of Center Core Igniters	957
5 80 4141	Effects of Long Idle Periods on Electrically Lines	510
5 80 4150	New Manufacturing Processes for SAWS Ammunition	220
5 80 4161	Production Techniques for Improved SMOKE Munitions (81mm)	380
5 80 4180	Automate Final Assembly Operations of M483/M509	761
5 80 4182	Process Improvements and Auto Test for RAAM, GEMSS, GATOR	438
5 80 4184	Form Sabot Segments to Net Shape on APFSDS Ammo	425
5 80 4187	Forming Boom of Heat Ammo by Upset Forging	325
5 80 4200	TNT Crystallizer for Large Caliber Munitions	300
5 80 4224	Energy Conservation in Solvent Recovery Operations	600
5 80 4225	Red Water Pollution Abatement System	500
5 80 4226	On-line Monitors for Water Pollutants	400
5 80 4231	In-plant Reuse of Pollution Abated Waters	552
5 80 4236	Auto Lace Jackets for Center Core Charges	605
5 80 4244	Develop Automated Loading Equipment for Elec Primer Igniters	292
5 80 4246	Hazardous Material Drying Survey	110
5 80 4251	Automated Manufacture of Delay for M549 Projectile	897
5 80 4253	Auto High-rate Unpack Equipment for Mortar Prop Charges	496
5 80 4266	Manufacture, IHSP and Test Equipment for Magnetic Power Supply	341
5 80 4269	Material Handling on Fuze Mfg Lines	125
5 80 4274	Recovery and Regeneration of Propl Mfg Solvents by Auto Control	250
5 80 4281	Conservation of Energy at Army Ammunition Plants	1220
5 80 4285	TNT Equivalency Testing for Safety Engineering	400
5 80 4287	Dev of Detonation Traps for Improved Safety	371

FY80 MUNITIONS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
5 80 4288	Explosive Safe Separation and Sensitivity Criteria	758
5 80 4298	Evaluation of Hexamine Recycle on HAAP B-line	450
5 80 4306	Improved Process Control System for the 105mm M67 Bag Manufacture System	118
5 80 4309	Propellant Process Development for 120mm Tank Ammunition	1340
5 80 4312	Injection Molding for Production Explosive Loading	276
5 80 4313	Dev Lap Tech for Oper Req by Ger 120 MM Des Cart	280
5 80 4320	Combutible Cartridge Case Process	401
5 80 4341	Improved Nitrocellulose Purification Process	972
5 80 4414	Auto Proc Control of Solventless Propellant Paste Comp	205
5 80 4454	Auto Inspection Device Explosive Charge Shell (AIDECS)	1283
5 80 4474	Dehumidified Air for Drying Single Base Propellant	200
5 80 4492	Water Deluge System Application in Munition Plants	270
5 80 4493	Design Parameters for Large-scale Process Vessels	410
5 80 4498	Dev Meth for Consol and Auto Assy of Small Mines	584
5 80 4508	Process Improvement of Pressable RDX Compositions	500
5 80 6736	Tech Readiness Accel thru Computer Integrated Mfg (CAM)	287

EXHIBIT P-16 (PART I)

DUPLICATE

Date: 5 July 1978

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
(RCS CSGLD 1125(RI))

1. Project No. R-801019 (USAMIRADCOM) 2. 4250 3. Cost: .507M

4. Title: MM&T Process Demonstration - Conversion of Surplus Pentaborane to B_{10} - Reduce Cost of Carboranes

5. Facility/Contractor: USAMIRADCOM/Callery Chemical Company

6. Summary: a. Problem: The present MM&T low cost carborane process demonstration will pyrolyze diborane (B_2) to decaborane (B_{10}) and convert B_{10} to NHC. B_2 is available only from Callery Chemical Co. at a cost of 130.00/lb. Based on present yields, the B_2 contributes \$286.00 to the cost of each pound of carborane. Present production requirement for NHC is 15,000 lbs/year equivalent to about 33,000 lbs of B_2. b. Solution: Data show that mixtures of the B_2/B_5 can be pyrolyzed to B_{10} in the present designed equipment/process. Therefore, the government owned B_5 could be mixed with the B_2 to (a) increase the availability of the carborane above present supply of B_2, (b) delay capital investment in additional B_2 facilities, and (c) reduce cost of the carborane since available B_5 would be GFE. Implementation of this project could be accomplished with limited modification of the carborane facility. c. End Product: A process would be demonstrated for the co-pyrolysis of B_2/B_5 mixture to the desired B_{10}. There is about 300,000 lbs of government owned B_5 in storage which will produce about 158,000 lbs of B_{10}/NHC if the conversion (55%) is the same as achieved with B_2. It has been shown that B_2/B_5 ratios of 75/25, could be used. Implementation: The B_5 would be mixed with the B_2 and pyrolyzed to B_{10} in the present reactor system being installed at Callery. Capital equipment required to introduce the B_5 into the present reactor system is expected to be very low, much less than the cost of additional B_2 facilities.

7. Economics: Based on MM&T process demonstrations at Callery, the yield of B_2 to B_{10} will be about 55%. It is assumed that a similar conversion of B_5 to B_{10} will be obtained and the B_2/B_5 mixture ratio will be in the order of 75/25. Thus, 25% of the reaction mixture can be made up of B_5. Based on 15,000 lbs/year of NHC, augmentation of the B_2 with B_5 will save about \$1.031M/year or about 68.75/lb of NHC.

Project No. R801019 (USAMIRADCOM)

EXHIBIT P-16 (PART I)

DUPLICATE

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
RCS CSGLD 1125 (RI)

1. Project No. R803142(MIRADCOM) 2. 4250 3. Cost: .200

4. Title: MM&T - Production Methods for Low Cost Paper Motor Components

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: Problem - The purpose of this project is to establish the manufacturing methodology for producing low cost paper solid propellant rocket motor components. Rocket motor costs to meet design-to-cost production goals have dictated re-evaluation of motor component materials and fabrication processes. Since tactical missile cases comprise up to 50% of the propulsion system costs, emphasis must be placed on establishing new case manufacturing processes to lower total motor costs. Recent R&D efforts have led to the concept of adapting the motor component design to utilize tubular products to the maximum extent to achieve minimum production cost. One highly promising concept for motor components is the paper/matrix tube process. This process consists of laminating binder-coated strip paper on an accurately dimensioned mandrel, curing the laminate and cutting tubes to the desired length. The problem is to optimize mill fabrication procedures to obtain the lowest cost while increasing reliability. Solution - This project would optimize the mill fabrication procedures for paper laminate tubular products to provide production engineering data essential to current and future motor component requirements. End Items - End products of this project will include: (1) Manufacturing data which will consist of data for processing specifications, material requirements, equipment requirements, processing data and quality control data. (2) Technical reports on detailed manufacturing processes, test procedures and program results. (3) Components for rocket motor firing demonstrations. Implementation - After successful completion of this project, action will be required to disseminate results to project managers, other commands and other services. Special emphasis will be placed on applicability to those items scheduled for production. The project managers will be kept abreast of the progress on this project and will be requested to implement the benefits of this program.

7. Economics: This Agency has conducted a feasibility demonstration for a 6 inch diameter solid propellant motor utilizing the paper laminate tube concept. This R&D effort was conducted under DA Project Nr. 1M362303A214 and totaled 200K. This project will cost $275K for FY79 and $200K for FY80 The economic analysis for this project is based on the structural requirements for an area fire saturation mission of 50,000 units per year. This would represent a uniform annual savings of $5,845,700 per year over a four year period. Execution of this project will not have a significant impact on the environment.

EXHIBIT P-16 (PART I) Date: 1 Jul 78

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
RCS CSGLD 1125 (RI)

RECEIVED 5 JUL 1978

1. Project No. R803396(MIRADCOM) 2. 2597 3. Cost: .180M

4. Title: MM&T - Injection Molding of Low Cost - One Piece Nozzles

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: Problem - Currently, solid propulsion system nozzles are being fabricated by using a number of materials and components joined together by various techniques. Therefore substantial production time and cost are involved as a result of the multi-component construction. These components are performance driven with hardware manufactured using conventional methods by aerospace vendors. This leads to production costs dictated by the aerospace learning curve and the specific production quantity involved. Recent R&D efforts have led to the concept of adapting the motor component design to utilize new material concepts to the maximum extent to achieve minimum production cost. One such effort utilizes injection molding with advanced materials technology to fabricate one piece, low cost nozzles. Solution: This project will optimize the injection molding/new material process to produce one piece nozzles. This will be accomplished by materials selection, establishing molding processing techniques, establishing tool design parameters and evaluating prototype components. End Products - End products of this project will include: (1) manufacturing data which will consist of data for processing specifications, material requirements, equipment requirements, processing data and NDT control data. (2) Technical reports on detailed manufacturing processes, test procedures and program results. (3) Components for rocket motor firing demonstrations. Implementation - After successful completion of this project, action will be then to disseminate results to project managers, other commands and other services. Special emphasis will be placed on applicability to those items schedules for production. Equipment and hardware will be available for production items.

7. Economics: Feasibility demonstrations have been conducted by private industry with various injection molding/high temperature materials processes. This R&D effort was conducted under DA Project Nr. 1M362303A214 and totaled 150K. This project will cost .180M for FY78 and .180M for FY80. The economic analysis for this project is based on the structural requirement for an area fire saturation mission of 50,000 units per year. This would represent a uniform annual savings of $1,249,800 per year over a two year period. Execution of this project will not have a significant impact on the environment.

Project No. R803396 (USAMIRADCOM)

DUPLICATE

EXHIBIT P16 (PART I) Date: 1 Jul 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)

RCS CSGLD 1125 (RI)

1. Project No. R803404(MIRADCOM) 2. 4250 3. Cost: .160M

4. Title: MM&T Manufacture of Ultrafine Ammonium Perchlorate

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: Problem - The purpose of this project is to establish metholology for manufacturing high quality, reproducible ultrafine ammonium perchlorate (0.5 to 3 micrometers). High burning rate composite propellants for missile systems such as ATI, ALT, STINGER, ATAADS, AHAMS, and VIPER must use ultrafine ammonium perchlorate (UFAP) to achieve the required burning rates. Extensive R&D has established that the most suitable current process for producing this UFAP is by grinding with a vibroenergy mill. Propellants made with different UFAP grinds have burning rates that vary over an unacceptable range. The rate produced by each grind must be empirically determined with a series of costly and time consuming standardization mixes. Frequently because of unacceptable UFAP quality large UFAP grinds or propellant batches must be discarded because suitable compositional adjustments cannot be made to achieve the required burning rate. Moreover, the burning rate of a specific missile propulsion system, and hence its accuracy, will often be out of specifications because of the UFAP manufacture and reproducibility problem. Solution - This project will (1) establish a grinding method for the reproducible manufacture of UFAP, (2) Evaluate the UFAP quality and reproducibility in high rate composite propellant formulations, (3) Establish stringent UFAP quality control and process specification procedures, and (4) provide to the Government equipment and technical documentation for reproducible UFAP manufacture. This approach will eliminate the costly standardization mix procedure, and result in significantly improved missile ballistic reproducibility, accuracy, and reliability. End Items - End products of this project will include: (1) Manufacturers data which will consist of data for processing specifications, material requirements, equipment requirements and processing data; (2) technical reports on detailed manufacturing processes. Implementation - After successful completion of this project, action will be required to disseminate results to project managers, other commands, and other services. Special emphasis will be placed on applicability to those items scheduled for production.

7. Economics: This R&D effort was conducted under DA Project Nr. IM362303A214 and exceeded $505K. The funding for this project is: FY80 -.160M, and FY81 -.180M. The performance of this project will not have an adverse effect on the environment or violate safety standards. The economic analysis for this project is based on the structural requirement for a shoulder fired rocket motor of 1,000,000 units per year. This would represent a uniform annual savings of $1,968,000 over a seven year period. Execution of this project will not have a significant impact on the environment.

DUPLICATE

RECEIVED
5 JUL 1978

EXHIBIT P-16 (PART I) Date: July 1978

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)

1. Project No. R803447 (USAMIRADCOM) 2. 4250 3. Cost: $.375M

4. Title: MM&T Scale up and Demonstration of a Process for the Recovery of Carboranes from Waste/Scrape Propellant and Reject Motors.

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: a. Problem: The production cost of N-hexylcarborane (NHC) used in the VIPER and ATI missile systems is estimated to be about $400/lb. In the manufacture of the propellant, up to 10% may be rejected because it will not meet rather strict ballistic rate requirements. Based on a 250,000 lbs/year propellant production rate this would involve 25,000 lbs of scrap/waste per year equivalent to about 1500 lbs of NHC/yr. Considerable effort in R&D has been expended in developing a process for the recovery of the NHC from waste propellant. The propellant scrap is chopped up and soaked in pentane. The pentane/NHC solution is decanted from the propellant and washed to remove soluble solids. The solution is then filtered to remove insoluble solids, and then dried over anhydrous magnesium sulfate. The dry solution of NHC in pentane is then distilled, first to recover the pentane, and secondly to purify the NHC. b. Solution: Scale up and demonstrate the process to extract/recover the NHC from the waste/reject/scrap propellant and motors. The objective is to scale up the laboratory process to a scale such that a total process can be demonstrated. This process would be capable of further scale up to handle the waste/scrap/reject propellant from the VIPER and ATI missile systems. c. End Product: The end product of this program will be the demonstrating a practical process for the recovery of NHC from propellant. The technical data package will contain process description, operating process, scale up facility process drawings, equipment list, product recovery cost, facility operations cost, facility cost, safety considerations, and results of process demonstration. d. Implementation: At the successful conclusion of this project, a facility will be installed at the propellant manufacturing site to recover the NHC from waste propellant. Technical data package will be prepared.

7. Economics: The project is estimated to cost $.375M FY 80 and $.132M for FY 81. The project will result in a total savings, based on a five-year life of $1.98M. This assumes that 250,000 lbs/year of the propellant will be produced and that there will be about 10% reject/scrap/waste. This means 25,000 lbs per year of reject propellant or equivalent 1500 lbs/year of NHC at an 85% recovery rate. Over a five year period, 6,375 lbs of NHC would be recovered. The recovery cost is estimated at $90 per lb versus a production of $400/lb. Based on 1,275 lbs/year recovery, the estimated savings is $310 per lb or a total of $395,250 per year or $1,975,250 over a five year period.

Project No. $803447 (USAMIRADCOM)

EXHIBIT P-16 (PART I)

RECEIVED 5 JUL 1978

Date: 1 July 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)

1. Project No. R803448 (USAMIRADCOM) 2. 4250 3. Cost: .250M

4. Title: Recovery of Diborane in the Manufacture of NHC

5. Facility/Contractor: USAMIRADCOM/Contractor - Callery Chemical Company.

6. Summary: a. Problem - The Army has contracted with Callery Chemical Co. to construct and operate a facility for the production of N-hexyl carborane (NHC) which is required in the production of the VIPER and possible ATI missile systems. Diborane is a major high cost ($130/lb) ingredient used in the manufacture of the B_{10}/NHC. the facility under construction is designed to produce 1 lb of NHC from 2.2 lbs of diborane (B_2). Therefore, B_2 raw material contributes $286.00 per pound to the cost of the NHC. Present data indicates that the gaseous products leaving the $B_2 \rightarrow B_{10}$ reactors will contain approximately 8% unreacted diborane. If 85% of the predicted loss could be recovered, a cost savings of $257,600 could be realized. b. Solution: Laboratory studies show that the B_2 can be complexed with methyl sulfide (liquid). When the dimethyl sulfide-diborane complex is heated with zinc chloride, the B_2 is released. The B_2 released can then be recovered and recycled to the reactors, rather than sent to an incinerator for burning. The loss of the B_2 not only increases cost of the end product but results in increased solid waste. The proposed process would be placed in service with the present facility design/operation, so that the effluent gasses are passed through the dimethyl sulfide solution before going to the incinerator. There the B_2 is extracted by complexing, pumping to a reactor where the zinc chloride is added to release the B_2 which is sent back to the reactor system, the dimethyl sulfide is recovered and returned to the complexing reactor. Raw materials, operation cost, and facility investments would be low, so that most of the projected cost savings would be realized. c. End Product: A process that can be used in existing carborane facility to recover expensive unreacted diborane which can be used rather than burned thus decreasing product cost, waste disposal cost, and facility operating cost. d. Implementation: The process will be added to existing carborane production facility as a process.

7. Economics: The project is estimated to cost $690,250 FY 80-81, and result in a savings of $1,288,000, based on a 5 year life. This assumes that 33,000 lbs of B_2 will be required to produce 15,000 lbs/year of NHC. With MM&T, the amount of B_2 will be reduced to 30,360 lbs/year with a savings of 2,240 lbs of B_2/year, assuming 85% recovery of the 8% B_2 loss. Estimated cost to recover the B_2 is $15/lb resulting in a net savings of $115/lb of recovered B_2 or a total of $1,288,000 over a 5 year period. Intangible cost factors include reduced solid waste materials and production cost. No major alterations in the present $B_2 \rightarrow B_{10}$ facility will be required to implement this process.

Project No. R803448 (USAMIRADCOM)

DUPLICATE

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EXHIBIT P-16 (PART I)
8152

DATE: 1 June 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No. 5801003 2. PA 4250 3. Cost: $240K
4. Title: MMT, Low Cost Molded Packaging for Hybrid Electronics
5. Facility/Contractor: Harry Diamond Laboratories/Contractor to be selected
6. Summary:

a. Problem. Thick film hybrid circuitry is extensively utilized for artillery, mortar, and rocket fuzes, and is planned for use in small caliber (30mm to 40mm) rounds. All of these fuzes are high-quantity, low-cost devices that must survive an extremely high "g" environment. To achieve high "g" survivability, these hybrids are presently foam or epoxy potted, in place. These methods, however, do not provide adquate environmental protection; conventional hybrid packages, such as hermetic packages, are not used due to cost considerations.

b. Solution. Develop a process for high-volume, low cost, sealing and protection for hybrid thick film circuits and other fuze electronics. This project will apply molding techniques now used for making dual-in-line plastic packages to larger hybrid circuits. The process to be pursued is based upon bulk film protection of the substrate, followed by molding of the electronics, and, in specific cases, metal plating of the molded module to provide electrical shielding. This method will provide better environmental protection for the electronics, and, as by-products, a lower cost encapsulation due to shorter cure times, and less environmental problems due to the outgassing of foams during the curing cycle.

c. End Product. A process, and associated equipment for low-cost packaging of electronic circuits. The end product of this PEM project will be a technique for encapsulating the M734 amplifier by molding, and equipment for doing so on a continuous production basis. The process and equipment will be easily adaptable to other electronic designs.

d. Implementation. The process validated by this project will be included in applicable fuze procurements. The return on investment (ROI) from the result of this program will occur by the government's placing orders to procure production quantities of fuzes.

e. Technical point of contact for this project is J. Ansell, Autovon 290-2840.

7. Economics

a. (1) Related R&D Funding: FY77-$20K (DARCOM No.1L662616AH77); FY79-$15K(DARCOM No.1L662603AH18-14)
   (2) Related PEM Funding: FY78-$50K (2763093)

b. Economic Analysis. A successful molded module package would result in a packaging savings of about $.20 per fuze. At any one time, one of the M734, M732, or XM587E2/724 fuzes will be in production at a conservative rate of 50,000 per month, yielding an annual savings of $120,000 per year per fuze type.

c. Environmental Effects. The environmental consequences of this project have been assessed and the approved EIA dated 1 May 1978 is attached. No significant environmental effect is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5801296 (ARRCOM) 2. GP: 5397 3. Cost: $400

4. Title: MMT: Manufacturing Technology for CB Filters

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: CB filter procurement has always been characterized by small unscheduled orders, limited industry response to contract solicitation and heavy reliance by contractors on DA for manufacturing technology needed to meet contract commitments. Also, in recent years, industrial response to contract solicitations has steadily decreased. If this continues, the industrial production base for many filters will be jeopardized. Contributing factors are:

(1) The processes require unique equipment and skills

(2) Competitive advantages have been gained by established producers in the form of proprietary and undisclosed process improvements

(3) Existing technology, as provided by DA, does not provide sufficient assurance to the producer of consistently producing items that are acceptable to DA.

b. The solution:

(1) Project 5761296 ($350K) identified process problem areas and initiated the solutions of four of them; namely, charcoal handling, charcoal filling of filters, whetlerization of charcoal, and filter quality control.

(2) Project 5781296 ($654K) initiated the prove out of the charcoal filling solution on a pilot scale. It will perform a hazards analysis, and continue the evaluation of equipment for quality control and charcoal handling, and initiate the solution of three other problems -- dust/humidity control, compaction of deep beds, and evaluation of the relationship between process controlled parameters and filter performance.

(3) Project 5791296 ($400K) will complete the pilot scale prove out of conventional charcoal filling processes and prepare designs for prototype production models; initiate the prove out of deep-bed filling process; continue the acquisition of basic data for dust and humidity control; establish correlation between process parameters and filter performance; develop process control techniques; and evaluate concepts for diagnostic testing of filters.

(4) Project 5801296 will complete the evaluation of commercial equipment for handling charcoal; prepare handbooks for controlling dust and humidity in filter manufacturing plants and for diagnosing production problems; install a process engineering facility.

c. The end products of this project are:

(1) Process data, process baseline, and manufacturing and testing methods as an effective production base for industry for each CB filter.

(2) An available process engineering facility for future process engineering, engineering support for production, and assistance to contractors in trouble.

d. The implementation: Methods and data will be made available to prospective contractors. Pilot equipment facility at Chemical Systems Laboratory will be used for resolution of production problems, and evaluation of new process technology. Process baseline will be incorporated into procurement packages for production contracts.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 26 April 1976, are available. No significant environmental impact is anticipated nor is any environmental controvsery expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1804 as follows: FY76 - $350; FY78 - $654, FY79 - $400, FY80 - $400.

b. Benefits of this program are non-quantifiable. Effect of not continuing the MMT would be:

DATE: 1 April 1978

(1) Sole source dependence for several critical items

(2) Continued dependence on undocumented industry techniques, unquantified process conditions, and unique manual skills; and inability to establish new production processes. An approved Economic Analysis (Format B) is attached as inclosure 2.

c. This project will not adversely affect the environment or violate safety standards.

5801296

EXr T P-16 (Part I)
815.

DUPLICATE

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DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5801318 (ARRCOM) 2. PA: 4250 3. Cost: $479

4. Title: MMT: Establish Chemical Production and Fill, Close, and LAPT Technology for Projectiles, 8" VX-2, XM736

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: The 8" Binary projectile, now under development, will type classify in 1st Qtr FY79. Also, the Navy/Air Force Bigeye Binary is now under development and will type classify in FY80. After they are typed classified, they cannot be produced unless this MMT project for conversion of development technology into production processes (including establishment of acceptable waste treatment and pollution abatement procedures) is approved. One of the chemical intermediates (QL) will be produced in-house. Methods for containment and treatment of chemical wastes from the QL process at NAAP must be established to meet current EPA and OSHA requirements before VX binary production is possible. A particular problem is the caustic water wash which is generated at a rate of 6 lbs per lb of QL produced. The QL process also generates a variety of organic phosphorus waste compounds. The deep well disposal method previously used is no longer acceptable. Volatiles must be contained and treated and the potential problems of air pollution and odor control must be addressed.

Equipment and procedures used in an existing experimental Development Test (DT II) fill line for QL and NM will be utilized to execute this project, but must be modified to provide design data for full-scale production . LAP equipment must be established to load the QL canister into the projectile on a unique side loading pallet. Because QL deteriorates upon contact with moisture, a dry inert atmosphere must be provided for the QL fill area. NM has a noxious odor which poses problems for operating personnel and for environmental contamination. The parameters for insuring leakproof closures must be established.

b. The solution: Extablish processes to reduce waste by-products from QL manufacture and provide methods for ultimate disposal of unavoidable waste material. Modify, adapt, and operate existing DT II fill, close, and LAP equipment to provide data required for the design of a full-scale production facility. See para 10 for more detail. This is a 2 year effort. A FY79 project for $398K is currently in the apportionment budget.

c. The end products of this project are: The end products will be all necessary data and technology required to design a production facility (including waste treatment and pollution abatemement) as proven out during pilot operations. This information will be contained in a final technical report.

d. The implementation: Results of the FY80 project will be combined with the results from the FY79 project to represent the complete technology necessary to design a facility. Process data obtained from both projects will be used in the follow-on omnibus project for design and a FY83 IPF, 5830320, will follow for establishment and operation of a full-scale production facility.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 25 March 1975, are available. No significant environmental impact is anticipated nor is any environmental controversey expected to be associated with this action. An EIS is not required.

7. Economics:

a. R&D funding up through FY79 has amounted to $15,706K, with $2,771K funded for FY78.

b. An economic analysis is not required since there is no alternative.

c. The execution of this project will not have an adverse effect on the environment.

EXI .T P-16 (Part I)
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DUPLICATE

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5801345 (ARRCOM) 2. OP: 5397 3. Cost: $458

4. Title: MMT: Mfg Methods and Tech for the Biological Warning System

5. Facility/Contractor: ARRADCOM, Dover, NJ/Bendix Environmental Sciences Division, Towson, MD

6. Summary:

a. The problem: The Biological Detector and Warning System, composed of the XM2 Sampler, the XM19 Biological Alarm, associated Refill Kits, and Remote Alarms, is the only item which can provide biological agent detection capability to the Army. A full and complete manufacturing methods and technology project must be completed on the item to minimize problems during production. The Biological Detector and Warning System presents unique, difficult, and challenging production engineering problems. The two major sub-systems, XM19 Alarm and the XM2 Sampler are complex, scientific instruments of sophisticated design. They involve scientific disciplines of aerodynamics, chemistry, electronics, and systems analysis, and require competence in mechanical, chemical, structural, and electrical engineering, and unusual aspects will dominate the production engineering effort.

b. The solution: Perform engineering studies of problem areas identified by a PEP to insure production processes that will bring about more readily reproducible and less costly components. Of particular concern are the tape and drive assembly, liquid system, electronic logic, refill kits, vibrating pumps, and sequencing solenoids. The areas most critical to success of the Alarm System are 1) the tape transport system, 2) wash station assembly and 3) the particle impactor. The producibility aspects of these areas are being addressed by the FY78 MMT 5781345. Producibility and source identification for 1) the premix solutions, 2) adhesive tape, and 3) fluid pumps are the primary subjects of the FY79 MMT project. Studies concerning manufacturing methods and 1) collector-concentrator, 2) wash station, 3) impactor, 4) reaction cell, and 5) electronic circuitry initiated in FY79 will be completed in this FY80 MMT. Additionally, in FY80 producibility studies of the following items will be initiated and completed: 1) tubing and fittings, 2) sealing, 3) cable crimping, and 4) thermal electric cooler heater.

c. The end products of this project are: The total program will result in a fully documented and proven manufacturing method for use in production, and an item of assured reproducibility, with a minimum of sole source items that can be acquired on a broader base.

5801345

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d. The implementation. All information gained will be included in the TDP, and made available to prospective producers.

e. The Environmental Impact Assessment: The environmental consequences of the project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 22 March 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,466 as follows: FY78-$480, FY79-$538, FY80-$458. Preceeding Government sponsored efforts for the biological alarm through FY78 for R&D are $24,160K.

b. An MMT project on items of such complex magnitude is a normal progression in the life cycle development.

DUPLICATE

JP

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCHD-165 (R1)

1. Project No: 5801348 (ARRCOM) 2. OP: 5397 3. Cost: $199

4. Title: MMT: Super Tropical Bleach

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Super Tropical Bleach, STB, (NSN: 6850-00-297 6653 is an effective decontaminating agent for blister agents including mustard (H), Lewisite (L) and ethyl-dichloroarsine (ED). It is also effective against G and V nerve agents. STB is chlorinated lime, containing 25-30% available chlorine, to which about 6% calcium oxide has been added. The US has been dependent upon a foreign source for STB since Pennsalt Chemical scrapped their STB plant in 1954. During the Korean era the Marshall Rudge Tube Process STB plant was constructed using a trade secret process licensed from ICI. However, the Marshall Plant at Natrium, West Virginia, was never operated since a low cost STB was available from a European source (Imperial Chemicals Industries). This STB plant was disposed of in 1964. The American market uses a 70% available chlorine content calcium hypochlorite, known as HTH, therefore, US industry has been unable, or unwilling, to manufacture STB as presently specified. As a result of these actions there is no US source for the chloride of lime ingredient in STB. Promising decontaminants have been tested, including modified HTH. With the wearing of special protective clothing and following proper safety precautions, HTH and several other decontaminants have been accepted for use in specific situations as field expedients. These agents are listed in TM 3-220 together with specific uses and necessary safety precautions. However, no product has been found to meet the military characteristics as it was too corrosive to decontaminating equipment and subjected military personnel to severe burns and their clothing to damage. Also, these substitutes are not as effective against all warfare agents. Recently the Army's mobilization requirements have increased to 748,611 drums (50 pounds each). Thus, a major shortfall exists between the FY78 requirements for this item and the quantity of imported chlorinated lime known to be available.

b. The solution: This project will consist of a two-phase effort. In phase one, process studies will be conducted to develop the technology required for the basic design of a super tropical bleach facility. For phase two, pilot equipment will be obtained and process module studies conducted on all critical operations which would be required in a super tropical bleach facility. These studies will include investigations into

pollution abatement and control equipment as required to insure that the future facility will meet OSHA and EPA standards. Emphasis will be placed on developing a continuous process rather than a batch process to minimize handling the materials, thus reducing product cost and minimizing plant manpower.

c. The end products of this project are: This project will provide process baseline and equipment data as the basis for design of a facility for producing super tropical bleach. STB is a component of the M12A1 Decontamination Apparatus, a PEMA end item.

d. The implementation: The data obtained from this project will be utilized to provide the basic design for a super tropical bleach facility. A follow on MM&T is planned for the performance of phase two, pilot studies, of this project. Data obtained from phase one and two will lead to the establishment of a facility.

e. The Environmental Impact Statement: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) date 15 December 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An Environmental Impact Statement (EIS) is not required.

7. Economics:

a. The total cost of this project will be $1056 as follows: FY80-$199; FY81-$857.

b. There are no current RDTE efforts associated with super tropical bleach. STB is a stock item. It was type classified in the 1950's. An STB facility is planned. At this time there is insufficient data available to perform a cost estimate for such a facility.

c. Execution of this project will have no significant impact on the environment.

8107

EXHIBIT P-16 (Part I)

DATE: 1 April 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

1. Project No: 1902 (ARRCOM) 2. PA 4250 3. Cost: $263
4. Title: MM&T- Manufacturing Methods of Gel Fuel for FAE Bombs BLU-95/B and BLU-96/B
5. Facility/Contractor: NWC/CL, NAPEC, HWAAP, and Private Industry
6. Summary:

a. The Problem: With the projected introduction of second generation Fuel Air Explosive (FAE II) weapons into the Navy and Air Force inventories, there is a need to provide a mobilization base for the production of the required ammunition. The ammunition is being designed in two sizes - one of 500 lbs and one of 2,000 lbs. The volatile, flammable fuel, propylene oxide, used in the Fuel Air Explosive bombs BLU-95/B and BLU-96/B, is a serious fire hazard in the event of fuel container rupture or other fuel spillage. The fire hazard is largely alleviated by eliminating flowing fuel in the event of fuel container rupture or fuel spillage with the use of gelled fuel, thereby increasing safety during bomb loading, storing, handling and shipment.

b. The Solution: A process procedure and manufacturing technique will be determined which will be suitable to mass produce a thixtrophic gel containing propylene oxide fuel, to transport the gel, and to load the gel into FAE bombs. Investigations will be performed evaluating currently available processing equipment. Attention shall be focused on adaptability to ordnance manufacturing use, maintainability, and repeatability of product. Batch and continuous mixing designs will be investigated. Similar reviews will be conducted on equipment necessary to transport the gel and to load the gel into FAE bombs. Where commercial equipment is not readily adaptable to the desired process, feasibility studies shall be conducted to develop mechanisms which would demonstrate the maximum manufacturing rates to be expected. Using the results of the above studies, a manufacturing sequence of operations and design criteria for full scale production equipment will be determined. A prototype pilot line of equipment would be specified, fabricated and used to demonstrate the process techniques in a production mode for each size bomb.

c. The End Products: Initial results will define the critical process parameters and equipment design criteria which will be necessary to specify production type equipment to produce and load FAE bombs with gelled propylene oxide fuel. The prototype equipment will be available to test process variables to compensate for potential changes to component material or configuration. The major thrust of the program will be directed toward development and demonstration of a prototype pilot line which could be duplicated in a production facility.

d. The Implementation: This data will be incorporated into the facility projects (P-15) providing initial production facilities to produce the FAE bombs BLU-95/B and BLU-96/B.

7. Economics: This program is a two year effort beginning in FY 80 - $263K; FY 81 - $371K.

8097
EXHIBIT P-16 (PART 1) 1 APR 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (R1)

1. Project Number: 1903 (ARRCOM) 2. PA: 4250 3. COST: $1187K

4. Title: Die Cast Tailcone for BLU-96/B

5. FACILITY/CONTRACTOR: Naval Weapons Center, China Lake/Honeywell, Inc.

6. SUMMARY: a. Problem:

The Blu-96/B Tailcone should be die cast to reduce machining and lower the unit cost.

b. Solution: Develop an articulated die for 2000 ton die cast press.

c. End Product: A die casting die suitable for making the BLU-96/B Tailcone.

d. Implementation: Acceptance testing and implementation will be at contractors plant.

e. Environmental Impact Statement: The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

f. There are no OSHA requirements in this project.

7. ECONOMICS: a. Total project cost is estimated to be $1187K to be funded as follows:

FY80 = $1178K
FY81 = 9K

These costs include installation and implementation at the selected contractor facility.

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD 165 (R1)

RECEIVED
4 MAY 1978

1. Project Number: 1904 (ARRCOM) 2. PA: 4250 3. COST: $439K

4. Title: One Piece Skin for BLU-96/B

5. FACILITY/CONTRACTOR: Naval Weapons Center, China Lake/Honeywell, Inc.

6. SUMMARY: a. Problem:

The BLU-96/B skin should be a one piece skin to eliminate leak paths and reduce machining and welding time.

b. Solution: Develop a tool suitable for fabricating 10 foot long internally grooved skins.

c. End Product: A tool for fabricating 10 foot long grooved skins.

d. Implementation: Acceptance testing and implementation will be at contractors plant.

e. Environmental Impact Statement: The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Assessment.

f. There are no OSHA requirements in this project.

7. ECONOMICS: a. Total project cost is estimated to be $439K to be funded as follows:

FY80 = $431K
FY81 = 8K

These costs include installation and implementation at the selected contractor facility.

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DUPLICATE MC

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804000 (ARRCOM) 2. PA: 4250 3. Cost: $470

4. Title: MMT: Automated M55 Detonator Production Equipment

5. Facility/Contractor: ARRADCOM, Dover, NJ, GOCOs/Iowa AAP, Burlington, IA/Kansas AAP, Parson, KS/Lone Star AAP, Texarkana, TX/Contractors to be determined

6. Summary:

a. The problem: Requirements for M55 Detonators and other initiators have risen to approximately 150M per month as a result of increased MOB requirements for ICMs. The current maximum production capacity is approximately 50M per month, using single-tooled detonator loading machines. This equipment operates at a maximum of 43 parts per minute, is highly labor intensive, requires a large amount of space, and utilizes manual operations in the areas of inspection, lacquer application, packout, and powder resupply, resulting in high costs.

b. The solution: This project is a production engineering measure to develop an automated M55 detonator production capability which will also be adaptable for the production of other initiating devices. Prior accomplishments utilizing FY71, 73-76 funding include the development and evaluation of alternate equipment concepts, and the design of a pilot system using continuous motion rotary turrets. Under a related MMT, Proj 57T4457, an improved multi-tooled Iowa loader was conceived and designed, and fabrication was initiated. FY77-78 funds were used to conceive and initiate design and fabrication of equipment to automate inspection, lacquering, packout, and powder resupply operations, and to initiate or accomplish a number of other improvements to the basic multi-tooled loader. FY79 funds were used to complete development, fabrication, and installation of the automated equipment modules, and to accomplish equipment and process improvements based on experience gained in operating the basic multi-tooled loader. FY80 funds will be used to complete system integration test, debug, and to complete related documentation.

c. The end products of this projects are: This project will result in an operating prototype of the multi-tooled loader, incorporating automated inspection, lacquering, and packing equipment, and other improved functions.

d. The implementation: Detonator production equipment based on the design developed in this project will be procured for all future detonator production facility projects.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $7,119 as follows: FY71-$340; FY73-$410; FY74-$549; FY75-$100; FY76-$1000; FY7T-$250; FY77-$1000; FY78-$1400; FY79-$1600, and FY80-$470. Additional P-15 funding of $5000 will be be required for production equipment for each facility project.

b. The economic benefits of this project include a savings of $3000 in equipment investment costs, and an annual operating cost savings of $41,700. The discounted uniform annual cost for the proposed equipment is $16,170 vs $58,310 for the existing equipment, a differnece of $42,140 per year.

5804000

DUPLICATE JP

EXH. P-16 (Part I)
8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804007 (ARRCOM) 2. PA: 4250 3. Cost: $93

4. Title: MMT: Evaluation of Acetic Anhydride Recycle

5. Facility/Contractor: ARRADCOM, Dover, NJ/Holston AAP, Kingsport, TN

6. Summary:

a. The problem: In the acetic anhydride manufacturing process at Holston Army Ammunition Plant (HAAP), a major source of water pollution is the barometric condensers and steam ejectors in the "E" scrubber effluent line. The current process uses barometrics to condense and cool the discharge steam issuing from steam ejectors. As a result, on the basis of 10^6 lb/day of anhydride production at MOB, these barometrics discharge 1.03 million gallons a day of process water contaminated with 863 pounds of acetic acid plus various other hydrocarbons and noncondensables. The noncondensables (103 ft^3/min) vent to the atomosphere and the condensate enters the barometric seal, from which it is discharged to the industrial sewer. These streams contribute to both air and water pollution. In addition, the process also uses large quantities of steam and cooling water.

b. The solution: It is proposed to modify the current process by replacing the water scrubber, steam jet ejector, barometric seal, and drain sump with a liquid seal ~~vacuum pump~~ using surface heat exchangers for cooling ~~instead of contact exchangers~~. The non-condensible gases will be injected into the cracking furnaces as a fuel supplement. A pilot plant study of this modification has already been successfully accomplished by Construction Engineering Research Laboratories (CERL). This effort was a direct result of recommendations presented in a Water Management study of the acetic anhydride manufacturing facility that would make the process environmentally sound as well as more economical. It is now necessary to verify the results of CERL's work on a full-scale unit at HAAP.

As a result of this project, effluent water pollution will be eliminated, saving more than a million dollars on the cost of waste treatment facilities and approximately $129,000 per year for operation of these treatment facilities. In addition to these savings, process water requirements would be reduced by about 0.92 MGD ($74K/yr savings), steam requirements would be reduced by 257,000 lb/day ($49K/yr savings), and contaminant recovery and reuse would add another $113K/yr savings. Operating costs would drop from $124K/yr to about $10K/yr.

c. The end products of this project are:

(1) Technical reports and technical data detailing prototype operation.

(2) Design criteria for modification of the remaining 15 units of the present acetic anhydride manufacturing facility at HAAP.

d. The implementation: The end product of this effort can be applied to the modernization of HAAP.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project wil be $409 as follows: FY79-$316 and FY80-$93.

b. There are both monetary benefits, which result from a very short amortization period and continuing cost benefits after amortization, and non-monetary benefits as a result of conformance to Federal and State Pollution Standards and Executive Orders.

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DUPLICATE JP

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804027 (ARRCOM) 2. PA: 4250 3. Cost: $304

4. Title: MMT: Combined Solvent Recovery/Drying of S-B Propellant

5. Facility/Contractor: ARRADCOM, Dover, NJ/Radford AAP, Radford, VA

6. Summary:

a. The problem: The conventional method of drying single-base propellants in the batch facility requires considerable time and labor to load and unload the separate solvent recovery, water dry, and air dry tanks and to transport the propellant between operations. Previous work indicates that the three drying operations can be combined into a single tank to obtain considerable savings in labor and energy.

b. The solution: An existing solvent recovery tank will be modified for the combined solvent recovery, water drying, and air drying operations. The prototype tank will be evaluated for the drying of SP and MP propellents (See 8.). This project will establish equipment and methods for a combined drying process with rapid steeping water drying for affecting energy conservation and cost savings in the manufacturing process.

c. The end products for this project are:

(1) Prototype equipment for the solvent recovery and drying of 58,800 lbs/month of single-base propellant in a single tank.

(2) A final engineering report containing test data and a thorough technical and economic assessment of the project.

(3) Process design and criteria for implementing solvent recovery and drying of single-base propellant under a single-tank concept.

d. The implementation: Subsequent to the successful completion of this project will be the conversion of 16 additional solvent recovery tanks to support a limited production level of 1,000,000 lbs/month. Conversion of all 135 existing solvent recovery tanks is not desired since there would not be sufficient capacity to meet

mobilization requirements of 10,500,000 lbs/month. An important related aspect of this project is that the automated single-base lines (CASBL), as presently configured, do not have the versatility to produce flake propellant. Therefore, if any full modernization takes place in the form of CASBL's, some batch facilities will have to be retained to maintain the capability to produce flake propellants.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $574 as follows: FY80 - $304 and FY81 - $270.

b. The benefits resulting from this project will be:

(1) A savings of $478 per year and an ROI of 23%.

(2) An appreciable reduction in drying cycle time with a corresponding reduction of pollutants escaping to the atmosphere.

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DUPLICATE

JP

DATE: 1 June 1978

RECEIVED
14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804033 (ARRCOM) 2. PA: 4250 3. Cost: $151

4. Title: MMT: Caustic Recovery from Sodium Nitrate Sludge

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Sodium nitrate is a by-product in the production of RDX/HMX. Under present operating conditions at Holston AAP, 70% of the sodium nitrate is recovered at a cost of $97/ton and has a purity of 96%. This nitrate is sold for $17/ton. (Loss of $80/ton). The remaining sodium nitrate is recovered as 71% nitrate, 20% formate and 8% acetate and transferred to lagoons for solar evaporation.

b. The solution: The object of this project is to thermally convert all the sodium nitrate, formate and acetate to the oxide which upon hydrolysis forms the hydroxide with the evolution of large quantities of heat. The heat evolved can be used in various phases of production, i.e., to dry the $NaNO_3$ sludge and the hydroxide reused to causticize the excess nitric acid. This solution will result in a savings of $63/ton $NaNO_3$.

c. The end products of this project are:

(1) A pilot plant

(2) A final engineering report containing test data and recommendations for implementation at Holston AAP

(3) Data base for scale-up to a plant scale nitrate to oxide conversion unit.

d. The implementation: The plant-scale equipment will have to be installed and evaluated at Holston before a return on the investment will be realized.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $536: FY80 - $151, FY81 - $260, FY82 - $125.

b. The benefits resulting from this project will be:

(1) A savings of $24.4 million per year and a ROI of 212%. The ROI will be much higher if cost of steam continues to climb as in the past.

(2) The sale of sodium nitrate as fertilizer at a loss of $80/ton = $1.25 million/year (Present Rate) will be eliminated.

(3) A savings of $63.59/ton of $NaNO_3$ produced will be obtained.

(4) Elimination of sodium nitrate pollution.

(5) Recycling of nitrogen oxides to make nitric acid.

(6) Recovery of energy.

c. Execution of this project will have a significant beneficial impact on the environment. Pollution by sodium nitrate will be eliminated.

EXHIBIT P-16 (Part I)
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DUPLICATE

JP

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804037 (ARRCOM) 2. PA: 4250 3. Cost: $415

4. Title: MMT: Process Improvement for Plastic-Bonded Explosives

5. Facility/Contractor: ARRADCOM, Dover, NJ/Holston Army Ammunition Plant, Kingsport, TN

6. Summary:

a. The problem: The present methods for the production of PBX compositions necessitate the use of facilities which may be required for the manufacture of Composition B during mobilization. Due to this restraint a limitation in the production capacity for both Composition B and the PBX compositions exists. This production level is inadequate for meeting current mobilization requirements.

b. The solution: This project will generate complete design criteria for processes sufficiently adjustable for the manufacture of PBX compositions at mobilization levels. This project will include the investigation of present processing methods as well as applying new technology to coating, drying, and finishing PBX compsitions. Applicable to this project is information gained in the preliminary investigations carried out on Project 57T4252 and 5774252.

c. The end products of this project are: The end result will be a final technical report containing sufficient engineering information to design new improved production facilities and a complete description of new methods, equipment, and technology for processing these explosives.

d. The implementation: In order to gain the benefits of this project the proposed changes will have to be implemented into production at Holston AAP or the new RDX/HMX facility or both.

e. The Enviornmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

5804037

7. Economics:

a. The total cost of this project will be $1,647 as follows: FY80, $415 FY81, $1,259.

b. The benefits resulting from this project will be improved product quality, decreased unit cost, safer operation, and increased process efficiency. A more efficient process design will release equipment currently required for this explosive for the production of other products.

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DUPLICATE

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DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804048 (ARRCOM) 2. PA: 4250 3. Cost: $375

4. Title: MMT: Dev Methods f/Proc Anal of RDX/HMX Anhydrous Slurry

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801/Contractor to be determined

6. Summary:

a. The problem: Continuous, automated manufacture of RDX/HMX requires the measurement and control of different in-process materials at various critical points in the process streams for efficient process operation. As a result, a different analytical technique is required to perform each measurement. In addition, because each process stream involved is different, a separate and unique sample preparation system is required for the retrieval and conditioning of each sample prior to measurement. This is because the materials present in a sample, other than that being measured, will usually have an interference effect and result in erroneous measurement unless the interfering material or its effect is eliminated from the measurement stage. Problems areas which require immediate action included in this submission are listed as Task 1, "Nitrolysis Reactor Slurry Control", Task 2m "Hexamine/Acetic Acid Solution Control", and Task 3, "Control of Acetic Acid".

b. The solution: This project involves three process streams in the RDX/HMX manufacturing process. Each of these streams is different both in terms of materials present and in terms of materials being measured as critical process control parameters. It is proposed that the listed problem areas be solved as shown under the individual tasks.

c. The end product of this project are: This project will result in prototype sampling and analysis systems, design packages for future additional procurement and a final engineering report containing test and evaluation data.

d. The implementation: The developed automated process control equipment will be intially installed in "D" buiding at HAAP, which is the only plant currently producing RDX/HMX by continuous nitrolysis of hexamine. Ultimately it will also be incorporated into the X-Facility and Holston designs.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are availaible. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. Total cost of this project will be $375 as follows: FY80-$375 (Task #1 - $132K; Task #2 - $127K; Task #3 - $116K).

b. This is a new program designed to develop methods and purchase, test and evaluate equipment for automated sampling and analysis of materials in the continuous RDX/HMX manufacturing process. The sampling and analysis for these materials is a critical process control function that is required for efficient operation. The benefits from this program will be reduced exposure of personnel to hazardous chemicals and explosives, and more reliable and precise control of the reactor variables, resulting in savings of $2,300 at full mobilization production. This project will not have an adverse affect on the quality of the environment.

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DUPLICATE

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804059 (ARRCOM) 2. PA: 4250 3. Cost: $783

4. Title: MMT: NQ Crystallization for continuous Propellant Lines

5. Facility/Contractor: ARRADCOM, Dover, NJ/Radford AAP, Radford VA/Sunflower AAP, DeSoto, KS

6. Summary:

a. The problem: A facility for the manufacture of nitroguanidine is nearing completion at Sunflower AAP. This facility will replace the only current source of nitroguanidine which is terminating production. The facility design is based on the British Aqueous Fusion (BAF) process modified with recycle loops to meet pollution requirements and to increase efficiency. The pure nitroguanidine crystallizers are specified to manufacture a smaller particle size than currently specified. Information is required on the effect of these changes in nitroguanidine particle size and other characteristics upon processing operations in the continuous manufacture of propellant compositions. A prototype line for multi-base propellant production is being evaluated at Radford AAP. Information from this line will be the basis of design for multi-base facilities in the modernization plan.

b. The solution: An evaluation program will be conducted on the continuous multi-base prototype line, to provide limits for particle size and bulk density control in the continuous manufacture and use of nitroguanidine including recommendations for tolerances in crystallization parameters and in continuous propellant manufacturing conditions. New quality control test methods and a comprehensive quality assurance system will be developed.

c. The end products of this project are: Improved specifications for nitroguanidine, fully characterized effects of nitroguanidine physical properties automated on triple base manufacture performance, and improved processing procedures for both nitroguanidine and propellant.

d. The implementation: Production procedures and a quality assurance system for nitroguanidine acceptance will be implemented upon completion of the program.

e. Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), Dated 1 April 1977, are available. No significant environmental controversy is expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,292 as follows: FY80 - $783, FY81 - $509.

b. Economic Analysis: This work is necessary to determine the adequacy of the nitroguanidine and its particle size range produced by the SAAP facility to meet the ballistic requirements and performance of propellant produced on automated production lines. The analysis of this project indicates an ROI of 40.7%.

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804061 (ARRCOM) 2. PA: 4250 3. Cost: $467

4. Title: MMT: Nitroguanidine Process Optimization

5. Facility/Contractor: ARRADCOM, Dover, NJ/Sunflower AAP, DeSoto, KS

6. Summary:

a. The problem: A nitroguanidine production facility is under construction at SAAP (Facility Project 5752632) and is scheduled to be operational in FY79. It is the first nitroguanidine plant erected in the United States. It utilizes processes not previously used commercially and it contains many recirculation and support loops, the operation of which are strongly interdependent. A second facility project (585B059) is planned.

b. The solution: Conduct process improvement studies using Nitroguanidine Support Equipment (NSE) installed under Project 5752632, and apply Evolutionary Operation (EVOP) to the nitroguanidine facility being constructed at Sunflower AAP. EVOP is a continuing statistical procedure for the analysis of the effects of systematic plant operational changes to optimize operating conditions. Application of EVOP techniques will lead to reduced pollution and energy consumption, and more economical operation while maintaining product quality and production requirements. EVOP will determine existing bottenecks which can be remedied in future plant design, and economic feasibiity of modifing the existng plant.

c. The end products of this project are: This project will provide a final technical report, improved operating conditions, proposed modifications to the existing facility, improved design for future plants, operating personnel trained in Evolutionary Operation and a functioning EVOP program for continued process improvement.

d. The implementation: The end products will be applied to existing and future nitroguanidine plants. The EVOP technique may be applied to other facilities.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available at LCWSL, MTD. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

EXHIBIT P-16 (Part I)
8152 DATE: 1 June 1978

7. Economics:

a. The total cost of this project will be $3,311 as follows: FY80 - $467, FY81 - $990, FY82 - $990 and FY83 - $864.

Each nitroguanidine plant supported costs approximately $140 million.

b. This project when implemented will reduce construction and operating costs through the use of improved design and operating conditions, and a reduction in out-of-spec product production. The economic analysis shows a savings to investment ratio of 4.28 and a return on investment of 33.1%.

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DUPLICATE

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DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804062 (ARRCOM) 2. PA: 4250 3. Cost: $1100

4. Title: MMT: Auto Manufacture Sys f/Mortar Increment Containers

5. Facility/Contractor: ARRADCOM, Dover, NJ/Indiana Army Ammuniton Plant, Charlestonw, IN/Unknown Contractors

6. Summary:

a. The problem: This continuing project will complete the development of a manufacturing system for a new felted explosive propellant charge increment container for the 60MM (M204) and 81MM (M205) Mortar Ammunition. Manufacturing experience to date has been primarily in support of developmental needs and has been based on manual methods keyed to small quantities. Capabilities of the private companies can be expanded and at least partially automated in the course of future production. However, the manufacturing capabilities of the private companies are inadequate to meet the mobilization requirement Alternate II volume. The container costs are high and, to provide the manufacturing capability to produce increment containers at Alternate II volumes, the Army must take action to develop a production base to meet mobilization requirements.

b. The solution: This program will develop an automated system for manufacturing the 60MM M204 and 81MM M205 propellant charge increment containers. A complete Technical Data Package for an automated propellant charge increment container manufacturing process will be provided to the Army; enabling the Army to establish a production capability to produce these containers on a mass production basis at either private or GOCO facilities.

c. The end products of this project are: A pilot production system for the manufacture of 60MM M204 and 81MM M205 propellant charge increment containers, equipment drawings to complete this system as a prototype and procure additional systems, a complete Technical Data Package, hazards analysis, production qualification program and technical reports.

d. The implementation: Successful completion of this project will provide the Army a means of expanding the private industry procurement base for the 81MM M205 and 60MM M204 propellant charge increment containers and the capability to procure automated production manufacturing processes for these containers to meet mobilization requirements. The Technical Data Package developed from this project will be used to implement a broad procurement base for both GOCO plants and private contractors.

5804062

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,607; FY79 - $507, FY80 - $1100.

b. Development of the automated propellant charge increment container manufacturing process for the 81MM M205 and 60MM M204 mortar ammunition will provide the Army a means of achieving container production requirements at an economical cost. It is estimated that automation of the current process can provide a yearly cost savings of $23.4 million for the 81MM M205 increment container and $4.2 million for the 60MM M204 increment container which will provide a ROI of 230%.

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DUPLICATE

AK

DATE: 1 Jun. 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804071 (ARRCOM) 2. PA: 4250 3. Cost: $250

4. Title: MMT: Explosive Dust Hazards in Munition Plants

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be determined

6. Summary:

a. The problem: This program will prevent explosion from occurring in dry dust collection systems and eliminate the need for detonation arrestors. Frictional forces on explosive, propellants, or pyrotechnic materials flowing through an atmosphere or the collision of particles with one another create static electric charges. Grounding devices have been universally accepted over the years as the primary method to safeguard against dust explosions by discharging these electrostatic accumulations. In spite of this protective measure, dust explosions have occurred in dry dust collection systems.

Potential hazardous dust conditions were discovered at the Indiana and Milan Army Ammunition Plants. Both the dust concentrations determined from air sampling and dust layer buildups on the floors and equipment found in the M-1 propellant bag loading operation in Indiana indicated that as much as 1 oz/ft^3 of M-1 propellant dust could be present in the atmosphere. Since only 0.024 joules of energy is required to detonate 0.045 oz/ft^3 of M-1 (human body can generate 0.020 joules) the threat of an explosion hazard exists. In Milan AAP, Composition B is exhausted from the drilling operation of the 105mm HE round into a dry dust collection system. From three separators, 25-30 pounds of explosive dust (75-90 pounds total) is removed each hour. No data, such as the static charge buildups, or particle sizes and particle distributions present in the dust collected that exceeds hazardous levels have been established for this system.

Present data on the explosive or detonation characteristics of explosive, propellant or pyrotechnic dust are incomplete. The available data does not profile dust explosions with respect to concentration, particle size, temperature, relative humidity, or solvents present in the atmosphere. The impact that these variables have upon a dust explosion is vital in the design of an approach to prevent the propagation of an explosion or detonation. The data collected will also provide a better understanding of explosive dust hazards in production faciliies than is currently known.

b. The solution: The main thrust of this program will be the prevention of a dust explosion before it can occur. Preventing a dust explosion shall be contingent upon (1) exhausting dust from the atmosphere before it reaches concentrations of explosive proportions, (2) reducing the current density of the electrostatic charge

in the atmosphere by proper humidity control, (3) providing transport pipes with diameters that will not support the propagation of a detonation (critical diameter) (4) determining the exhaust velocity that will minimize the electrostatic build up yet maintain dust flow without fallout, (5) determining the concentration gradient across the diameter of the transport pipe and (6) determining proper vent ratios to relieve pressure buildups. To acquire this information, an in-process plant exhaust line shall be monitored. Dust samples will be taken and analyzed for composition, minimum concentration for explosion, minimum spark ignition energy, and minimum ignition temperature at different environmental temperature and relative humidities. Included, in this program will be a dust detection system capable of sensing an explosive hazard at a safety factor level.

c. The end product of this project are: Information will be obtained to design a dust collection system that will prevent a hazardous dust concentration from propagating from a deflagration to a detonation. This data will be formalized and published in the form of a technical data package.

d. The implementation: The information derived from the laboratory tests on the explosive nature of various propellant, explosive and pyrotechnic dusts can be utilized in the application of a dust detection system. Publication of this data can provide the Corp of Engineers with information necessary to install explosion proof systems in munition plants.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed, and approved results of the Environmental Impact Assessment (EIA) dated 1 July 1977 are available. No significant environmental controversy is expected to be associated with this action. An Environmental Impact Statement (EIS) is not required.

7. Economics:

a. The total cost of this project will be $525; FY80 - $250, FY81 - $275.

b. This project is concerned with improved safety. There are no trade-off alternatives, including the inaction alternative, which will meet the irreversible management decisions to provide a high level of safety consistent with the safety echelons' determination of "acceptable level of risks". The project therefore, appears to fall within the exceptions and does not require a quantifiable economic analysis as given in AR 11-28 (3). DARCOM Suppl 1 to AR 11-28 notes that non-quantifiable benefits will be difficult to justify unless they involve health, safety or security. The non-quantifiable benefits accruing will be increased protection for personnel, equipment and facilities by applying the Safety Echelon approved safety engineering data derived. Specifically affected will be design criteria for quantity-distance detonation propagation, structural and barricade response and classification involving accidental explosions. Monetary savings may or may not result, depending on the specific case, but in all cases, safer conditions will result.

EXHIT P-16 (Part I)
8152

DUPLICATE

JP

DATE: 1 June .78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804078 (ARRCOM) 2. PA: 4250 3. Cost: $320

4. Title: MMT: Upgrade Safety, Readiness and Productivity of Existing Melt Pour Lines

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Existing projectile loading lines require utilization of large quantities of explosive in batch processes. The design for modernization of the LSAAP line represents the ultimate in automation. However, this design requires substantial construction, all new process equipment and a complex control system. In addition the continuous process lacks flexibility for on line incorporation and for limited loading requirements.

b. The solution: This project will develop a series of process design concepts which will improve safety, reduce explosive quantities, remove personnel from hazardous areas, increase efficiency and reduce production costs. The process design concepts will utilize existing loading buildings, utilities and process equipment. The most cost effective approaches used in the LSAAP design will be incorporated. The project will also develop a series of design concepts which will allow for automation of existing melt pour facilities within a minimum time frame and with minimum equipment change over.

c. The end products of this project are: The results of this PEM program will be used to define the procedures for processing explosives in an automated batch pour.

d. The implementation: The results of this program will provide guidelines for automating existing melt pour systems at the GOCO facilities utilizing existing loading structures.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

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7. Economics:

a. The total cost of this project will be $535 as follows: FY80-$320; FY81-$215.

b. The utilization of an automated batch melt pour systems would result in a cost savings of $898 per year. The intangible benefits are:

(1) Provide a facility for limited production quantities on an automated batch process and for quantities in a continuous process.

(2) Provides a capability for establishing process parameters using a minimum quantity of items on a batch basis which easily can be converted to production quantities. The Return on Investment (ROI) is 30.7%.

c. The execution of this project will not have a significant impact on the quality of the environment. There will be a substantial improvement in the safety standards because this system is operated automatically.

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815.

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

JK DATE: 1 J 1978

1. Project No: 5804084 (ARRCOM) 2. PA: 4250 3. Cost: $110

4. Title: MMT: Opacity/Mass Emission Correlation

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801
Scranton APP, Scranton, PA and other AAP's with hot forging facilities.

6. Summary:

a. The problem: Present methods of large caliber ammunition production, especially the forging operations, result in smoke emissions that are strictly regulated by the Environmental Protection Agency. The EPA, additionally, will soon be enforcing recent regulations that require each plant to monitor its own opacity and mass emission. Unfortunately, the AAP's do not possess the required equipment or experience to meet these regulations. In order to prevent court action that could result in fines or shutdowns, the AAP's will be forced to rely on frequent, periodic monitoring studies contracted to private industry or to purchase expensive mass-monitoring equipment.

b. The solution: Preliminary investigation into this problem has indicated that there is a high probability, given the proper development, of using available and an inexpensive opacity monitor to measure and record mass as well as opacity. What is needed is the correlation between opacity reading and mass emission rate. With this correlation and an inexpensive opacity monitor, AAP's will be well-suited to meet the new EPA regulations.

c. The end products of this project are: A correlation developed on-site at the AAP's. Charts will be prepared to convert opacity readings to mass emission rates. A report will be prepared and published.

d. The implementation: This project will not supply the AAP's with monitoring equipment. Procurement of such equipment will have to be made by the AAP's.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 21 March 1977, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. Total cost of this project is $231 (FY79-$121; FY80-$110). The correlation to be supplied under this project requires no implementation costs. To implement this correlation, each AAP will be required to purchase an opacity monitor. Cost to each AAP is approximately $7000 for equipment and installation. This will not be charged to MMT, but implementation costs are included in the economic analysis.

b. This project is not approved as a cost reduction program, but rather as a result of pollution abatement regulations applicable to AAP's. However, there are some cost savings as shown by Inclosure 2.

c. The performance of this project will have no adverse effect on the environment or violate any safety standards.

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DUPLICATE JP

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804086 (ARRCOM) 2. PA: 4250 3. Cost: $350

4. Title: MMT: Reprocessing Explosive Fines and Drill Scrap

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Currently, the explosive scrap generated from the fuze cavity drilling and facing operations, and explosive fines in general, are burned as waste material by the GOCO facilites. Explosive fines cannot be reprocessed in its generated state because it agglomerates when introduced into the melt systems and cannot be processed by the melt equipment. Reprocessing of this scrap material would save the Army money and help reduce air pollution currently attributed to the burning process.

b. The solution: This program, utilizing standard commercial equipment, will develop and pilot an explosive fines and drill scrap reprocessing system. This system will screen, inspect and reprocess the fines into flake explosive that can be directly introduced into the load line melt-pour systems.

c The end products of this project are: A pilot explosive fines and drill scrap reprocessing system, a functional specification, hazards analysis and technical reports.

d. The implementation: Successful completion of this project will provide the Army a pilot process to recycle explosive fines and drill scrap into flake explosive. The Army will be provided a functional specification and the capability to procure full scale production equipment to process scrap material at mobilization rates.

e. The Enrivonmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. Development of a reprocessing system for explosive fines and drill scrap will provide the Army a means for utilizing explosive material currently discarded and burned as scrap. It is estimated that for the 81MM M374 Mortar, at mob production rates, an annual cost savings of $1,213 can be achieved by recycling the drill scrap, providing an ROI of 80%.

b. Total funding is the amount of $550 has been estimated for the project with program authorization required as follows: FY80-$350 and FY81-$200.

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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804137 (ARRCOM) 2. PA: 4250 3. Cost: $957

4. Title: MMT: Automated Loading of Center Core Igniters

5. Facility/Contractor: ARRADCOM, Dover, NJ and Contractors to be selected

6. Summary:

a. The problem: The center core igniters consist of a flat circular cloth bag, attached to a long slender cloth bag. Both of these bags are loaded with black powder. These igniters are presently manually loaded resulting in high labor costs as well as exposing the human element to hazardous operations and conditions.

b. The solution: This project will automate the loading operations of the 155mm, M203 and 8 Inch M188 Propelling Charge Igniters.

c. The end products of this project are: A prototype loading machine, a technical data package including requirements for quality control and quality acceptance and a final technical report.

d. The implementation: This project provides for installation and prove-out of the prototype igniter bag loader at a load plant to be selected. No additional government action is required to obtain a return on investment.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 July 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

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8152 DATE: 1 June 1978

7. Economics:

a. This is a 2-1/2 year program amounting to $1,162. FY79, $205 and FY80, $957.

b. Benefits to be derived from this project will be:

(1) Process modernization

(2) Improved safety

(3) Improved product reliability

(4) Increased production rates

(5) Cost reduction due to the reduction of personnel

c. Performance of project will not have an adverse effect on the environment or violate safety standards.

DUPLICATE

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8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804141 (ARRCOM) 2. PA: 4250 3. Cost: $510

4. Title: MMT: Effect of Long Periods of Non Operating Environment on Electronically Controlled Lines

14 JUN 1978

5. Facility/Contractor: ARRADCOM, Dover, NJ
Volunteer AAP, Chattanooga, TN
Joliet AAP, Joliet, IL
Lake City AAP, Kansas City, MO

6. Summary:

a. The problem: As part of the overall effort to improve and modernize the munitions production base, electronic control systems have been installed on various manufacturing lines. Many of these systems have been tested under production conditions and demonstrated smoother, and inherently safer operations of modernized facilities. Applications of modern control technology is anticipated in the future because of its potential benefits. However, current requirements for much ammunition are such that it has become necessary to place many present and future facilities in layaway. Since modernized munition plants would be expected to be available for mobilization for many years, enhanced design and procedural guidelines must be developed to assure readiness goals. Industrial experience or data on the degradation of industrial electronics while stored in a dormant mode is entirely inadequate. The proper technology must be developed if modernized munitions production facilities are to be capable of rapid reactivation.

b. The solution: A representative engineering system (or test bed) must be scrutinized to generate and correlate the data on the dormant degradation effects on the industrial electronic (includes electro-optic and related electro-mechanical) equipment used in modernized ammunition production. In lieu of obtaining equipment to generate the required engineering data, modern control systems at JAAP, VAAP and LCAAP will be used to achieve the above objective. Additional degradation data available from industry and other government sources, particularly related type Army plants, will be used to compliment experience gained at the prime sites. Suspect components when desirable, will be subjected to a thorough analysis in order to assess degradation and failure modes. This information will be used to generate guidelines for future system design to preclude from future systems, components and configurations deleterious to the readiness posture of these lines. In addition formalized procedural guidelines will be developed to handle this equipment in the standby state to assure the required readiness posture.

5804141

c. The end products of this project are: The end product of this program will be a set of designs and procedural guidelines defining the effects of long periods of non-operating environments on the class of industrial hardware used in electronic and electro-optic productive control systems in the plant modernization program. Products are: (1) technology base necessary to ensure that the manufacturing capability is not degraded by dormancy. (2) documentation of procedural guidelines to assure readiness of present and future modernization projects. (3) methodology to be applied during periods of non-operation to ensure restart and full production within the required time frame using prime lines on VAAP, JAAP and LCAAP as test beds to enhance early development of technology. (4) adjustment and/or verification of current spare parts provisioning.

d. The implementation: The results of this project will be to develop formalized procedural guidelines, based on the developed technology, for layaway, standby and reactivation of modernized plant electronic/computer controlled systems using the DDC continuous TNT lines and SCAMP lines as test vehicles for implementation.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 3 October 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics

a. Total cost of this program $1,490 as follows: FY78-$450, FY79-$530, FY80-$510.

b. No future costs are envisioned. Economic analysis are not primary considerations in this project. Rather, the effort will be undertaken in order to develop engineering data essential to the reliability and readiness of electronic productive control systems used in the production base. Use of existing army facilities as a test bed is highly desirable since it obviates purchase of extensive laboratory computer equipment to obtain the required data. While direct economic benefits are not attributable to this project, the technology developed may result in an equipment maintenance program which could potentially reduce placement costs, assure startup in adequate time and add a high degree of reliability for an efficient readiness posture period.

DUPLICATE HW

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804150 (ARRCOM) 2. PA: 4250 3. Cost: $220

4. Title: MMT - New Manufacturing Processes for SAWS Ammo

5. Facility/Contractor: ARRADCOM, Dover, NJ/Lake City Army Ammunition Plant; and Private Industry

6. Summary:

a. The problem: At the present time, there is a US Army program for standardizing XM777 and XM778 SAWS ammunition in the last quarter FY80. NATO is also evaluating this ammunition for possible standardization in the same time frame. Ammunition procurement is planned for FY81. There is no economic process currently available for the production of the SAWS penetrators, neither is there a SAWS bullet assembly capability on SCAMP equipment. All SAWS penetrators produced to date have been manufactured on single spindle automatic screw machines, a process whch is expensive. Assembly of the penetrators into bullets on a modified bullet assembly machine (BAM) was accomplished at approximately 25% of normal production speed (approx. 30 parts/min) resulting in added cost. This type of process, while acceptable for producing ammunition for test purposes, is not adequate for mass production. A project effort is required to develop manufacturing and assembly processes for the XM777 ball bullet capable of effectively meeting projected MOB requirements while providing economic production.

b. The solution: Solution to the problem requires that a process for the fabrication, handling and assembly (insertion) of the AP penetrator be developed in an expeditious time frame. Viable alternatives exist for each of these areas. Penetractors can be fabricated by multispindle screw machines, powder metaulurgy, cold heading and, skewed axis roll forming processes. These processes represent production capabilities ranging from 40 PPM to 3000 PPM per machine. Methods of feeding and inserting the penetrator into the penetrators with insertion on of penetrators with insertion on line prior to lead insert, and an alternate off line process approach which generates a steel penetrator/lead core hybrid. This hybrid will be bulk fed into the bullet submodule of conventional bullet assembly machine in a fashion typical of the present pointed lead slug handling systems approach. The potential exists for direct utilization of existing bullet assembly equipment and design in this later approach. Regardless of the methods employed, orientation and feeding equipment development will be required to fill the needs for both conventional and New Generation production equipment systems. Requirements for process

control, inspection criteria, and other pertinent process functions will be addressed to provide a complete systems oriented approach to development of economical production processes for the manufacture of SAWS ammunition. Periodic reviews will be conducted to assess the needs for MMT development to support tracer charging requirements for the XM778 tracer bullet and to support changing packaging requirements.

c. The end products of this project are: The end product of this project will include prototype and production worthy process systems and technical data packages in the form of drawings, specifications, operation manuals and maintenance manuals suitable for competitive reprocurement.

d. The implementation: Implementation will include hardware for the manufacture of SAWS XM777 ball bullet penetrators, a penetractor feeding system breadboard and final technical; data packages.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed, and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are attached. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. This program will continue through FY80. The funding for this project is as follows: FY78 - 50; FY79 - 735; FY80 - 220.

b. The execution of this project will not have a significant impact on the quality of the environment, nor violate safety standards.

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DUPLICATE

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804161 (ARRCOM) 2. PA: 4250 3. Cost: $380

4. Title: MMT: Pdn Tech for Improved Smoke Munitions (81 mm)

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: The Training and Doctrine Command (TRADOC) has established the Smoke Obscuration Program as a very high priority program. A singular DARCOM Project Manager's Office has been established to control this high visibility smoke area. A letter of Agreement (LOA) for development of an 81 mm smoke cartridge was approved in December 1976. The LOA calls for type classification in the 2d Qtr FY82 and IOC in 3d Qtr FY84. Preliminary investigations indicate that either WP mix or a red phosphorus mix will be the candidate of choice that meets the requirements established by the LOA. If the fill material is RP, which has only been produced and filled on an experimental basis, process technology is required to prepare the smoke mix and load it into the munitions on a mass production basis. If the fill is WP, the effort will be reduced since some technology and equipment are available for application to a WP effort.

b. The solution: MMT project 5804161 will provide prototype equipment and conduct technology studies to determine the most feasible production method for smoke mix preparation, filling, closing, inspecting, and leak testing of these improved smoke munitions. The data obtained in these studies will provide all data and criteria for the design of an Initial Production Facility (IPF) for this munition.

c. The end products of this project are: The end products of this program will be a process baseline which will establish the design criteria for the Initial Production Facility.

d. The implementation: The results of this project will be utilized in an FY81 OMNIBUS design and an FY83 IPF project to provide the production capability for the 81 mm cartridge to meet the FY84 IOC date.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 5 October 1977, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS not required.

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7. Economics:

a. The 81 mm program is R&D funded for $1,595K in FY77; $700K in FY78; planned for $2,174K in FY79; $1,849K in FY80; $1,849K in FY81; and $1,612 in FY82.

b. No economic analysis is required since there is no alternative to the project.

c. The execution of this project will not have significant impact on the environment.

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PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

DATE: June 1978

RECEIVED
14 JUN 1978

1. Project No: 5804180 (ARRCOM) 2. PA: 4250 3. Cost: $761

4. Title: MMT: Automate Final Assembly Operations of M483/M509

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be Selected

6. Summary:

a. The problem: The present operations at Lone Star and Kansas AAPs are highly labor intensive for the insertion of the expulsion charge cup, staking the cup, expulsion charge insertion lifting plug insertion and torquing and rotating and grommet assembly. Each of these operations is performed manually while the projectile is transported through each station.

b. The solution: The proposed MMT effort should approach automating these operations and plan to interface with the current projectile transport system for simple integration at these two operations and future facilities.

c. The end products of this project are:

(1) Two pieces of automated equipment: (i.) Expulsion Cup and Charge Operations, and (ii.) Lifting Plug Engage and Torque.

(2) Technical Data Packages for the manufacture of duplicate production systems.

(3) Hazards Analysis, operation and maintenance manual, final report.

d. The implementation: In order to achieve the desired savings, P-15 facility projects will be required. It is envisioned that replicate systems will be installed at Lone Star, Kansas, Milan, Mississippi and Louisiana.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $761 as follows: FY80 - $761.

b. The return on investment for this project is 18.74% and the savings/investment ratio at 10 percent is 1.65. The savings is incurred through the reduction of 10 men by the implementation of the equipment.

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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804182 (ARRCOM) 2. PA: 4250 3. Cost: $438

4. Title: MMT: Process Improvements & Auto Test for RAAM, GEMSS, GATOR

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801 Contractor to be selected

6. Summary:

a. The problem: Presently the electronics assembly for the XM75 and BLU91/B mines utilize several all-hand work operations which are slow and expensive. These are:

(1) Potting operation

(2) MCD assembly production

(3) MCD to Lens assembly and

(4) Wave soldering operation

Other problem areas are:

(5) Testing electronic components and sub systems

Currently some electronic components are not tested or else tested after being assembled with consequent re-work often required, and digital and magnetic test times are very long, causing production bottlenecks.

b. The solution:

(1) Redesign Potting fixtures to eliminate preliminary hand operations and automate sprue cutting.

(2) Automate Magnetic Coupling Device (MCD) Assembly

(3) Automate MCD Assembly to Electronic Lens

(4) Improve process & design to prevent board warping and consequent loss of boards and reduce soldering rework which is presently a very expensive hand operation.

(5) Develop a high speed magnetometer tester, magnetometer core tester and diagnostic digital tester for electronic lens.

c. The end products of this project are:

(1) Prototype equipment to automate Potting Operation, MDC Assembly and MCD assembly to Electronic Lens

(2) Prototype equipment/process to improve wave soldering operation

(3) Magnetometer core tester

(4) High speed magnetometer tester

(5) Diagnostic digital tester

(6) TDP and a final report

d. The implementation: Acceptance testing and implementation will be at electronic lens contractors plant.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: Total project cost is estimated to be $602 (FY80-$438-FY81-$164)These costs include installation and implementation at the selected contractor facility.

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DUPLICATE

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DATE: 1 JUNE 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804184 (ARRCOM) 2. PA: 4250 3. Cost: $425

4. Title: MMT: Form Sabot Seg to Net Shape on APFSDS Ammo

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Current methods of making sabot segments is to use extruded bar segments, face off the side to 120° angle, clamp three segments together and machine approximately 2/3 of the starting material away to arrive at a finished sabot. This represents a material waste and extensive machining time, both of which result in high unit costs. In previous PEP efforts to forge sabot segments problems were encountered in maintaining dimensions following forging and subsequent heat testing due to relaxation of stresses induced during heat treating.

b. The solution: Continue PEP effort on forging to net shape, solution heat treat, dimensionally analyze after quenching, design straightening dies and cold straighten to eliminate distortion. The part will then be aged and again dimensionally analyzed to determine if any additional distortion occurred. Parts will then be finish machined to determine if any movement occurs during machining.

c. The end products of this project are: The end products will be a manufacturing process to form the sabot segments of APFSDS projectiles in lieu of machining from rod. This will result in a 70% savings in aluminum and an estimated total reduction in unit cost of $5.75.

d. The implementation: Additional equipment in the amount of $2,750,000. will be required to implement this process.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), date 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: There was no preceding Government sponsored R&D effort related to this project. This effort will not be duplicated on the 120mm RDT&E Program. The total cost of this project will be $425 as follows: FY80 - $425. No additional Government costs should be required to implement the PEM project results.

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804187 (ARRCOM) 2. PA: 4250 3. Cost: $325

4. Title: MMT: Forming Boom of HEAT Ammo by Upset Forging

5. Facility/Contractor: ARRADCOM, Dover, NJ/contractors to be selected

6. Summary:

a. The problem: The boom (tail fin extension) on HEAT rounds has a hub on one end for threading to the body which is approximately 2.5 inches greater in diameter than the remainder of boom. Currently this is machined from large diameter rod at a considerable loss in material. In addressing upset forging, the problem is expanding the minor diameter of the starting bar to approximately 2.5 times in size to form the hub end (note sketch) without damaging the integrity of the part.

b. The hub end will be expanded in two forming operations on a heading machince. The first operation will expand the end approximately 1.5 times the starting bar diameter. The second operation will expand to the required diamter while at the same time forming the cavity.

c. The end products of this project are: The end product will be an optimized manufacturing process for the boom resulting in a cost savings by starting with less aluminum alloy material.

d. The implementation: No changes to the technical data package is required. Additional equipment required to institute this process is estimated to cost $1,500,000.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment dated 1 April1978 are available. No significant environment impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics: There was no preceding Government sponsored R&D effort related to this project. The total cost of this project will be $325 as follows: FY80 - $325.

An estimated $1,500,000. will be required to implement the PEM project results. Results of an economic analysis indicate a savings of approximately $10.36 per projectile. This effort will not be duplicated with 120MM RDT&E funds.

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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804200 (ARRCOM) 2. PA: 4250 3. Cost: $300

4. Title: MMT: TNT Crystallizer for Large Caliber Munitions

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: There are no established processes for loading large caliber projectiles with TNT explosive on a continuous basis in the modernized melt pour lines. It is essential that specific process parameters and equipment be developed in order to produce an acceptable TNT explosive cast for the 155MM and 8 Inch high explosive munitions utilizing a continuous process. The "feathering" operation now required for TNT melt loading will be eliminated. The program effort is essential and is in the best interest of the government to develop new technology for processing TNT explosive This is an approved alternate filler for artillery projectiles.

b. The solution: This program effort will develop a continuous TNT crystallizer system for processing slurry of molten TNT containing up to twenty percent solids. The system will have the capability to closely control the percentage of solids incorporated into the molten TNT and the temperature of the explosive prior to the pour operation. This system will also eliminate double probing and explosive top off operations which are required for processing TNT on a batch basis. The project will identify and establish the load line conversion requirements that must be implemented to process TNT with the new crystallizer system. Process parameters will be defined for the Army's alternate preferred filler in high explosive loaded artillery ammunition.

c. The end product: The results of this PEM program will be used to define the procedures for processing TNT explosives on a continuous basis in the melt-pour system for mass production LAP lines.

d. The implementation: The results of this program will provide guidelines to implement the processing of TNT explosives in the melt-pour systems at the GOCO facilities.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 Apr 78 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this project. An EIS is not required.

7. Economics:

a. A preliminary program to develop the TNT crystallizer was initiated at Iowa Army Ammunition Plant during the 1950's. Equipment was fabricated and testing initiated using TNT explosive. A problem developed with the scraper blades and the program was terminated before the problem was resolved. The results from the preliminary program will be utilized in this project effort. The study for the crystallizer was initiated during CY53 under Project titled "The SPCC Melt-Pour-Cool Process Research and Development Program costing approximately fifty thousand dollars. The utilization of a continuous TNT crystallizer system vs the present batch system would result in a cost savings of $374/year per line. The intangible benefits are (1) the experience and know-how gained from operating the TNT crystallizer on a continuous basis and (2) provide a significant improvement in safety due to less personnel exposure and the elimination of human judgement. The Return on Investment is 32%.

b. Total cost of this project will be $650 as follows: FY80-$300; FY81-$350.

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DUPLICATE AK

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804224 (ARRCOM) 2. PA: 4250 3. Cost: $600

4. Title: MMT: Energy Conservation in Solvent Recovery Operations

5. Facility/Contractor: ARRADCOM, Dover, NJ/Radford Army Ammuniton Plant, Radford, VA

6. Summary:

a. The problem: A review of unit and process operations at Army Ammunition Plants by TRW Inc has determined that the activated carbon solvent recovery operation affords a high potential for energy savings by the use of heat transfer technology.

b. The solution: The energy consumption of the activated carbon solvent recovery units can be significantly reduced by use of a fume recirculation system based upon a TRW concept in place of the present steam distillation process. This project will install and evaluate such a fume circulation system.

c. The end products of this project are:

(1) A prototype fume circulation system.

(2) A final engineering report containing test data and a thorough technical and economic assessment of the project.

(3) Process design criteria for implementing remaining solvent recovery facilities.

d. The implementation: Subsequent to the successful completion of this project will be the installation of 6 additional recirculating regeneration systems for solvent recovery from the remaining activated carbon bed units at Radford AAP.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,397; FY80 - $600, FY81 - $797.

b. The benefits resulting from this project will be:

(1) A savings of $936 per year and an ROI of 20%.

(2) An appreciable reduction in energy consumption with a corresponding reduction of pollutants escaping to the atmosphere.

c. Execution of this project will have no adverse effect upon the environment or violate safety standards.

EXH" P-16 (Part I)
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DUPLICATE AK DATE: 1 Jul. 978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804225 (ARRCOM) 2. PA: 4250 3. Cost: $500

RECEIVED 14 JUN 1978

4. Title: MMT: Red Water Pollution Abatement System

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801/Radford AAP, Volunteer AAP

6. Summary:

a. The problem: Red Water (R.W), a dilute solution of sulfates, sulfonates and nitrated organics is produced in large volumes from the purification of TNT at Radford, Volunteer, Joliet and Newport Army Ammunition Plants. Its discharge to surrounding streams is prohibited and the current means of disposal do not provide a satisfactory solution.

b. The solution: Based upon assessment of current technologies, the Sonoco Sulfite Recovery Process (SSRP) was selected which will both eliminate pollution in streams and recover sodium sulfite from red water for reuse in the purification of TNT. Feasibility of this process has been demonstrated, however additional MMT efforts are required to establish the optimum operating parameters of the critical components such as the pelletizer, reduction kiln and scrubber, and also develop and optimize methods for clarification and purification of the final product. These efforts will be in direct support of a MCA project for Radford Army Ammunition plant.

c. The end products of this project are:

(1) Design data to support scheduled MCA project at Radford Army Ammunition plant as well as adaptation studies for implementation at the other TNT facilities containing design data, hazard and economic analysis.

(2) A final technical report.

d. The implementation: This MMT effort will produce the technical data for a modular optimum system for use at all TNT plants.

5804225

DATE: 1 Jun 1978

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $500 as follows: FY80 - $500

b. Monetary benefits will occur from the recovery of sodium sulfite solution which can be recycled for use in TNT purification. Non-monetary benefits will be realized from elimination of environmentally untenable waste disposal condition.

c. Funding requirement for FY80 may be reduced should late start FY79 funds become available upon approval by DARCOM and ARRCOM. Funding for this project has been given high priority at ARRCOM level as it materially affects FY81 MCA projects for R.W. Disposal at RAAP, VAAP, JAAP and NAAP.

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804226 (ARRCOM) 2. PA: 4250 3. Cost: $400

4. Title: MMT: On-Line Monitors for Water Pollutants

5. Facility/Contractor: ARRADCOM, Dover, NJ/GOCO to be chosen

6. Summary:

a. The problem: Army Ammunition Plants are discharging a wide variety of pollutants, most of which are unique to the military, which are hazardous and toxic. An ongoing study by the Office of the Surgeon General, is showing that many of the discharged compounds are far more toxic than expected. The 1977 amendments to the Water Pollution Control act stipulates that all pollutants must be monitored.

b. The solution: An R&D program has been underway for the past two years to develop instruments that are capable of monitoring the toxic and hazardous pollutants from the ammunition plants. These instruments include an electrochemical analyzer, a Raman analyzer, and a liquid chromatographic analyzer. Each is suitable for use on-line, for continuous monitoring. Each is adaptable to measuring any one of a group of pollutants, but, with any particular pollutant, one instrument will be more suitable than the rest. The purposes of this program will be to rank the instruments for suitability for monitoring a particular pollutant in a particular waste stream, to demonstrate the capabilities of the alternatives, to consider the cost-benefit ratios, to develop design parameters for a simpler, more economical instrument dedicated to monitoring a specific pollutant, and to evaluate the feasibility of using the instruments for automatic control of pollution abatement equipment.

c. The end products of this project are:

(1) Monitoring instruments for military unique pollutants in the wastewaters from ammuniton plants.

(2) Designs for more economical instruments which are dedicated to monitoring a particular pollutant in a particular waste stream.

(3) Means for complying with existing and future water pollution control regulations.

(4) Means for monitoring and controlling pollution abatement processes.

d. The implementation: The instruments will be installed on-line at various waste streams in ammunition plants. Instrument values will be compared with values obtained from standard lab tests.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed, and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $750 as follows: FY80 - $400; FY81 - $350.

b. The benefits resulting from this project will be:

(1) Compliance with monitoring requirements of regulatory agencies.

(2) Warning of accumulation of hazardous and toxic pollutants in the wastewater.

(3) Adequate time will be available to prevent the discharge of pollutants.

(4) Pollution abatement processes will be kept operating at peak efficiency.

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DATE: 3 June 1978

RECEIVED
14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804231 (ARRCOM) 2. PA: 4250 3. Cost: $552

4. Title: MMT: In-Plant Reuse of Pollution Abated Waters

5. Facility/Contractor: ARRADCOM, LCWSL, Dover, NJ/ARRADCOM, CSL, Edgewood, MD, Milan AAP and Iowa or Kansas

6. Summary:

a. The problem: The Federal EPA has set 1985 as the deadline for zero discharge of pollutants into the nation's waterways. Attainment of zero discharge may entail the development of advanced technology and/or expensive replicate treatment via state-of-the-art. Already costs of pollution abatement are skyrocketing and facility abatement project costs may become prohibitive. Also, related problems, such as the question of treatment plant sludge disposal, are arising and abatement plant throughput must be minimized.

b. The solution: The most direct way to achieve zero discharge of pollutants is not to discharge plant effluent in the first place. This concept combines abatement of wastewater contamination by some method of current state-of-the-art treatment with recycle and reuse of the abated wastewater within the plant itself. The treatment plant (secondary) would be reduced as a result of the application of the water management principles or recycle, reuse and product recovery to the manufacturing processes. The abated effluent would then be recycled within the plant wherever it has been determined that the pollutant level will not adversely affect the manufacturing process. Any remaining effluent would get tertiary treatment (carbon adsorption or ion exchange) in a unit of greatly diminished size, and would then be recycled within the plant.

The project will continue and amplify the FY78-79 work on in-plant recycle, extending it to active plants not previously addressed, as well as to inactive plants that might be reactivated if the need arises. It will be basically an analytical study, with some pilot work where necessary.

In the case of Milan AAP, for example, it is planned to treat 520,000 gallons/day of explosives loading waste water by carbon adsorption. Based on the recycling experience in Iowa AAP, at least 356,000 gallons/day of this flow can be recycled before carbon adsorption treatment. The remainder that passes through the carbon

adsorption columns would still have a trace of explosives, but would be recycled within the plant. Thus zero discharge would be achieved while cutting costs; not increasing them. Resultant annual savings are estimated at $845K due to reduced carbon requirement, $83K for recycled and reclaimed TNT, and $8K for treatment and pumping .52MGD of river water.

This project will: 1. Establish water specifications of all L/A/P process operations: 2. experimentally establish quality and quantity of water discharged from existing, designed and proposed water pollution abatement systems; 3. evaluate acceptability, practicality and economics of reusing partially and fully pollution abated wastewaters for the various processes; 4. determine minimum treatment of wastewaters to satisfy in-plant water specifications; 5. recommend most cost effective actions to be taken; 6. evaluate recommendations on a pilot scale when required for support of design criteria. This project will support current modernization efforts at all L/A/P plants; it will also reduce costs of many MCA projects. MAAP, LSAAP and either IAAP or KAAP will be addressed the first year.

c. The end products of this project are: Technical reports and technical data in support of design criteria for the establishment of cost effective pollution abatement systems based on in-plant reuse of pollution abated waters.

d. The implementation: The end product of this effort can be applied to the modernization of the Army Ammunition Plant network.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with the action. An EIS is not required.

7. Economics: The total cost of this project will be $981; FY80 - $552, FY81 - $429. It is anticipated that the resulting cost savings will be more than one order of magnitude than the program cost. The non-monetary benefit derived from this project will be pollution abatement at AAPs.

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804236 (ARRCOM) 2. PA: 4250 3. Cost: $605

4. Title: MMT: Auto Lace Jackets For Center Core Charges

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor(s) to be selected

6. Summary:

a. The problem: Large-size propelling charges such as the 155MM and 8-Inch charges employ laced jackets to maintain their configuration. The manual threading and tightening of the lacing on these jackets is a time consuming operation which results in poor quality, non-uniformity, high cost and personnel hazard.

b. The solution: The automation/mechanization of the lacing operations would improve quality and greatly lower production costs and personnel hazard.

c. The end products of this project are: This project will result in a prototype production machine with appropriate installation, operation and maintenance manuals for installation and use at an X-facility. Also provided will be a complete set of fabrication drawings, purchase and performance specifications in order to replicate the machine as required. A summary engineering report will provide full developmental data including performance tests, RAM data and a hazard analysis.

d. The implementation: A prototype production machine will be designed, built and tested by a commercial contractor for delivery to a designated GOCO plant. The effort will be directed and evaluated by ARRADCOM engineering units and supported by OGA specialty services such as GFM supply, hazard analysis/testing, etc. ~~Installation and~~ live run in support of IPF 5802694 will be required before a return on the investment will be realized.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

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DATE: 1 June 1978

7. Economics:

a. The total cost of this project will be $605 for the MMT prototype development project with an additional $500 required for the acquisition of two more replicate machines on Facilities Project 5802694 in order to achieve the required 10 charges per minute production on which the economic analysis is based. Dollars are constant FY78 dollars.

b. The benefits resulting from this project will be:

(1) A saving of $480,000 per year and an ROI of 31.3% at FYDP Rates.

(2) Non-quantifiable benefits of improved product quality and personnel hazard conditions.

c. Execution of this project will not have an adverse effect on the environment or violate safety standards.

DUPLICATE

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EXH ? P-16 (Part I)
8152

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804244 (ARRCOM) 2. PA: 4250 3. Cost: $292

4. Title: MMT: Develop Automated Loading Equipment for Electric Primer Igniters

5. Facility/Contractor: ARRADCOM, Dover, NJ/Lone Star AAP, Texarkana, TX/Contractor to be selected

6. Summary:

a. The problem: Electric primer igniters are presently produced on a line where hand operations dominate. The new slurry, soon to be implemented, will require new equipment and methods of handling. The new system may still be essentially a hand line, unless careful, systematic planning and design is done.

b. The solution: This project will be coordinated with the LAP facility to effect a high degree of automation in the loading operation. The line production rate will be geared to the latest projections for electric primer igniters.

c. The end products of this project are: An automated prototype loading system to produce electric primer igniters at projected MOB rates, a procurement package for replication of any or all of the equipment, manuals of operation and maintenance and a final report will be the yield from this project.

d. The implementation: It is anticipated that installation and implementation will be at Lone Star AAP. Costs of installation, debugging, and proveout are included in the funding of this project. No additional funding should be required based on constant FY78 dollars and prevailing inflation factors.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

DATE: 1 June 1978

7. Economics:

a. Total cost of this project will be $528 as follows: FY80-$292; FY81-$236.

b. A non-quantifiable benefit is increased safety due to a reduction in operator personnel and less manual handling. It is estimated that two operators will be saved, as shown in the economic analysis. Calculations in the economic analysis were done in FY78 dollars.

c. Execution of this project will not further degrade the quality of the environment.

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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804246 (ARRCOM) 2. PA: 4250 3. Cost: $110

4. Title: MMT: Hazardous Material Drying Survey.

5. Facility/Contractor: ARRADCOM, Dover, New Jersey

6. Summary:

a. The problem: Over the past decade, millions of dollars have been spent in developing processes for drying propellants and explosives. Perusal of existing reports indicates that better awareness of past and on-going efforts would have provided valuable lessons for dryer selection and evaluation; however, there has been no disciplined attempt to correlate the data in a form which would be more generally usable.

b. The solution: The approach will be to review all existing reports and on-going projects related to the development and operation of drying processes whether the source be the Government or the commercial sector. The data obtained will be correlated in a manner that both economic and technical aspects can be assessed by reference to a series of nomographs or tables. The intent is to provide a single reference which can be used in future propellants and explosives drying process developments.

c. The end product of this project is: A technical report which will review efforts in developing processes for drying propellants, explosives, and other hazardous materials, and will offer guidelines for drying process developments.

d. The implementation: The results of this project can be implemented by insuring that the information developed is being used in all MMT projects related to drying. A broad distribution of the report and its use as a technical management tool by project officers will expedite implementation.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of The Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. Several million dollars have been spent on drying process developments; however, no funds have been expended on correlating the results of all those projects. The proposed is a one-year $110. (FY80) effort. No implementation costs will be required following completion of this effort.

b. The benefit of this project is that the use of the information produced from this project will provide a comprehensive source for the project engineer which will streamline his efforts in all phases of MMT and facilities efforts. Because of the nature of the project objectives, a quantitative economic analysis is not applicable.

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DUPLICATE JS

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804251 (ARRCOM) 2. PA: 4250 3. Cost: $897

4. Title: MMT: Automated Manufacture of Delay for M549 Projectile

5. Facility/Contractor: ARRADCOM, Dover, NJ/Lone Star AAP, Texarkana, TX, Contractor to be selected

6. Summary:

a. The problem: The present process for manufacturing the delay assembly for the M549 155mm Projectile is a hand line operation which requires a high man hour input per unit produced. Sixteen operators are required to produce 600 delays per 8 hour shift. A large number of the operations deal with explosive loading thereby exposing operating personnel to the inherent hazardous operations. Automatic assembly of the delay may be inhibited by the current design and minor changes in metal parts may be beneficial to facilitate automation. The delay for the XM 650, RA, HE, Projectile is of a similar design and the same problems are therefore anticipated.

b. The solution: The automatic feeding and orientation of the delay body and other metal part components will be accomplished. All delay, igniter and flash materials will be automatically measured, dispensed and consolidated. Operator involvement will be limited to supply and maintenance function, thereby reducing exposure to hazardous operations. Recommendations with regard to product change to facilitate automation will be made if deemed necessary to facilitate production.

c. The end products of the project are:

(1) A prototype production machine tooled for manufacture of finished M549 delay assemblies and capable of utilization for manufacture of XM650 delay assemblies after acquisition of toooling.

(2) Elimination of 12 operators from the production line.

(3) Upgraded skill level of production personnel.

(4) Complete technical data package for equipment and tooling for both M549 and XM650 delay assemblies and recommendations for metal parts changes to facilitate production of these items.

5804251

d. The implementation: The prototype machine will be installed and evaluated at Lone Star Army Ammunition Plant. The prototype machine will meet the FYDP production rates and no additional acquisitions will be required to support production rates. A metal parts technical data package change may be required. Acquisition of tooling to produce XM650 delay assembies will be accomplished on a future facility project.

e. The Environmental Impact Assessment: The environmental consequence of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total project cost will be $897; FY80 - $897.

b. Based on the most likely FYDP production rate, the economic analysis shows a return on investment (ROI) of 43%. A non quantifiable benefit is the increased safety due to the significant reduction on operator involvement in the handling of initiator compositions.

c. Execution of this project will have no adverse effect on the environment.

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DUPLICATE

DATE: 1 Jun. 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804253 (ARRCOM)   2. PA: 4250   3. Cost: $496

4. Title: MMT: Auto High-Rate Unpack Equip for Mortar Prop Chgs

5. Facility/Contractor: ARRADCOM, Dover, NJ - Milan, AAP, Milan, TN - Contractor to be selected

6. Summary:

a. The problem: The automated load, assemble and pack (LAP) line for the Mortar Propelling Charges M204 (60MM) and M205 (81MM) developed under Project 4041 requires hand unpacking at the beginning of the line and hand packing at the end of the line. Also, each of the automated complete round assembly lines installed or being installed in KAAP, LSAAP and MAAP (Project No 2163, 2692 and 2505, respectively) require hand assembly of the loaded increments to the mandrels feeding the Propelling Charges to the charge assembly stations. An estimated 3.4 line personnel are required in the two charge LAP operational areas and in the complete round line. The prevalence of line personnel in these operations can result in interruption of feed of parts, damage of parts and potentially unsafe conditions due to the human element and handling of energetic materials. More safe, reliable and economical unpackaging and packaging processes are required.

b. The solution: Develop automated equipment for the above operational areas. The unpacking equipment will automatically unpack the increments and then feed them to the mandrels of the three first automated stations on the LAP line and the two charge assembly stations of the complete round line. The packing equipment will automatically pickup the trays holding the filled or loaded increments, place them into the packing box and feed and place the support bars and sheets for the next layer of trays. The above equipment will consistently control forces applied to the empty or fill increments, eliminating any chance of damage. The packaging has already been designed to permit automated unpackaging or packaging. The need for above 5 line personnel will be eliminated.

c. The end products of this project are: Two prototype equipment, one for unpackaging and the other for packing, for the propelling charge LAP line and an adaptation kit for unpacking the live increments will result from this project. The above two prototype equipment will be suitable for installation in the charge LAP line to be installed in MAAP in FY80. The design of the adaptation kit for the complete round unpacking equipment for future procurement will result form this project. Also, all necessary documentation (drawings, specifications, manuals etc) will be prepared for procurement, operational and maintenance purposes.

5804253

d. The Environmental Impact Statement: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $496 as follows: FY80 - $496. The two prototype equipment developed will be suitable for installation in the first charge full LAP production system installed in a GOCO plant, namely, MAAP under Project No 5802007. Only one each of the unpacking and packing machines will be required to support the 128 increments-per-minute design rate of the full production system.

b. This equipment will be more efficient, economical to operate, safe and reliable than the current hand operations. Both of the machines will perform their tasks for either the M204 (60MM) Charge or the M205 (81MM) Charge by a quick tool change. The combined labor savings of the two machines will be 3.4 man-yrs per year per line (1-8-5 basis). The labor savings on unpackaging machine for the complete round line is 1.2 man-years per year per line (1-8-5 basis). The improved reliability will be effected by machine design and elimination of the human error. The improvement in safety is effected of course by eliminating the need for line personnel and special attention to design of the machine in handling the increments. The return on the investment based on the Economic Analysis is 32.9% at the mobilization rate (for MAAP) for both equipment (for the charge LAP line) combined and 12.6% and 14.5% for the charge LAP equipment and charge LAP/complete round combined, respectively equipment at projected FYDP rates (on the line at MAAP considered to be the most economical systems). This project includes the funding of GFM parts procurement and GOCO plant equipment installation and acceptance test and these costs are included in the Economic Analysis.

c. Execution of this project will not have an adverse affect on the environment nor violate safety standards.

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DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804266 (ARRCOM) 2. PA: 4250 3. Cost: $341

4. Title: MMT: Manufacturing, Inspection and Test Equipment f/Magnetic Power Supply

5. Facility/Contractor: ARRADCOM, Dover, NJ/Bulova

6. Summary:

a. The problem: Piezoelectric power supplies used in HEAT ammunition have been observed to leave undesirable voltage generation impressed on the electrical circuiting of the round due to shock vibrations resulting during flight. While not conclusively proven to cause premature functioning it is considered significantly hazardous to warrant elimination of this undesireable effect.

b. The solution: PIP IA 87533 for the improvement of the M456A1 HEAT cartridge includes the safety and cost saving modification of moving power supply from the nose of the round to inside the PIBD fuze housing and changing it to a magnetic pulse generating type power supply which is unaffected by the aforementioned shock vibrations. Additionally, the reference PIP results in a validated per round cost saving of $5.39. Initiating in FY79 and culminating in 4Q81, the PIP program requires a two year MMT program to acquire the manufacturing, inspection and testing methods and technology to produce the magnetic power supply. This type of power supply which has found use in other munitions such as guided missiles (larger and withstanding and responding to relatively lower gravitational forces) has never been produced in the physical size and quantities required for Artillery, Tank or Mortar Ammunition. The methods and technology obtained will be for full or partial automation as quantities and cost dictate. The MMT will be applicable to future generation ammunition such as the PIBD fuze for the XM815 HEAT-MP-T 105mm cartridge and the PIBD fuze for the 120mm XM1 Tank HEAT-MP-T cartridge.

c. The end products of this project are: The GOCO hardware and equipment acquired under this project will provide for automated or semi-automated production of Magnetic Power supplies at a cycle rate of 10 seconds. Additional end products will be accumulated; manufacturing, inspection, and testing data and a final report. This item can be used for other products, some of which are yet to be designed. Its size is favorable for easy adaptation and its Modular Construction can offer it as an "off-the shelf" item for a multitude of applications. Ease in manufacturing resulting from this effort will increase its potential for future use.

5804266

d. The implementation: The results of this project will be implemented in the production line for the product improved PIBD fuze resulting from PIP 1A87533.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 13 March 1978. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,042 as follows: FY80 - $341, FY81 - $701

b. The benefit resulting from this project will be: A safer, more reliable and economical type power source will be made available for PIBD fuzes and an automated or semi-automated method will be provided to produce them.

AD-A067 887 ARMY INDUSTRIAL BASE ENGINEERING ACTIVITY ROCK ISLAND IL F/G 13/8
MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR FISCAL YEAR 19--ETC(U)
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EXH. .T P-16 (Part I)
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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804269 (ARRCOM) 2. PA: 4250 3. Cost: $125

4. Title: MMT: Material Handling on Fuze Mfg Lines

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: The existing intra-line handling for the M739 fuze manufacturing line is labor intensive. This derives from the fact that the various sub-assemblies in discrete assembly centers. Each of these assembly centers has its own unique handling requirements. Some components are directly adaptable to commercial feeding and orienting techniques. Where feasible, this has been accomplished. Elsewhere, both feed and discharge functions for these assembly centers have posed unique problems. The problems required methods to provide orientation, prepositioning, protection and surge capacity. As a result, magazines were developed to fulfill these needs at feed, discharge or both. However, the resultant manual handling of these magazines is labor intensive.

There is no commercial handling equipment that is specifically designed for this operation. No commercial equipment has been successfully adapted to the operation. The reason is that such an adaptation demands the ability to accomplish it with basic commercial equipment of moderate first cost; then adapt and tool it for this application. Up to this point, it has evidently not been feasible to do it cost-effectively.

A typical fuze line output is 500,000 units/month. The existing line is a prototype and present modernization plans call for replication.

b. The solution: This project is offered as a study effort to develop a solution based on retaining the use of the magazines in the dynamic mode because of the benefits this provides. Search the commercial field for the latest state-of-the-art equipment that can be adapted to this operation. There are recent developments in the field. To cite some examples: There is new equipment on the market in self-powered, self-contained driverless carriers designed for lighter loads than their predecessors, the driverless tractors. Second, there are new programable robots which are designed for light loads and are less sophisticated than the expensive units.

They possess more degrees of freedom and greater adapability than the usual pick and places devices that they are designed to supplant. Third, some robots are now designed to be adapted for a transport function in addition to their usual, direct, interface function. Fourth, there are new cybernetic devices in human extender (multiplier) form. These are thought of only for those applications where it is essential to have human supervision of a particular interface. Lastly, the packaging equipment industry is continually producing new ways to handle odd shapes.

c. The end products of this project are: The end product will be a final report defining a concept for implementation, starting with the first M739 fuze assembly line.

d. The implementation: There is no direct implementation within the scope of this project. Implementation will result from a P-15 project.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 Apr 78 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $125 as follows: FY80 - $125.

b. Execution of this project will not have an adverse effect on the environment or violate safety standards.

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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804274 (ARRCOM) 2. PA: 4250 3. Cost: $250

4. Title: MMT: Recov & Regen of Propl Mfg Solvents by Auto Contrl

5. Facility/Contractor: ARRADCOM, Dover, NJ/Hercules, Inc, Radford AAP, Radford, VA

6. Summary:

a. The problem: The activated charcoal solvent recovery units at Radford Army Ammo Plant operate on a timed cycle, open loop, controlled basis. The time cycles were established by empirical calculations. However, the solvents content of the air passed through the charcoal beds fluctuates widely from time to time. As a result, operation of the solvent recovery units on a time sequence basis rather than an activated charcoal load capacity basis results in inefficient recovery of solvent and unnecessary use of thermal energy.

b. The solution: Maximum efficiency of the activated charcoal solvent recovery operation and thermal energy use can be achieved by using solvent detection instrumentation to determine when the activated charcoal is saturated on the adsorption cycle and when the activated charcoal is free of solvent on the regeneration cycle. Using a solvent detection system to determine the duration of each cycle would result in the most efficient solvent recovery system possible.

c. The end products of this project are: The end products will be a Technical Report, Test Data, and Design Criteria for conversion of a solvent recovery house to automated operation both at RAAP and other GOCO plants with similar recovery systems.

d. The implementation: Subsequent action to the successful completion of this project will be the purchase and installation of ~~similar controls~~ on the other two solvent recovery facilities at RAAP under PS & ER funding.

There will be a prototype.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

5804274

EI IT P-16 (Part I)
8152

DATE: 1 June 1978

7. Economics:

a. This will be a one year program requiring $250 for design, acquisition, installation and evaluation of a system installed in the original control are to operate one solvent recovery facility control system.

b. On the basis of current production rates for single-base propellants, the annual savings would amount to approximately $216/yr.

c. This project will not have an adverse affect on the quality of the environment.

5804274

EXHl P-16 (Part I)
8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804281 (ARRCOM) 2. PA: 4250 3. Cost: $1220

4. Title: MMT: Conservation of Energy at Army Ammunition Plants

5. Facility/Contractor: ARRADCOM, Dover, NJ/various GOCO Ammunition Plants/Contractors to be selected

6. Summary:

a. The problem: Concern exists that energy, in appropriate quantities, may not be available in the future to meet mobilization requirements at Army Ammunition Manufacturing and Loading Plants. Therefore, to insure mobilization requirements can be met, energy conservation measures must be identified and applied to the manufacturing processes of the ammunition plants.

b. The solution: Methods for more efficient energy utilization at Army Ammunition Plants will be determined. These measures will be immediate or short-term applications of current technology to the various industrial processes at Army Ammunition Plants. This effort will also determine technology requirements as it relates to explosive and propellant operations where immediate or short-term technology is not considered adequate. Efforts will be conducted to develop advanced technology in discrete segments based on potential economic payback to develop energy conservation methods.

c. The end products of this project are: This program will produce energy inventories/balances of specific unit processes, technical reports on the various subprojects, and recommendations stating where, what, and how much energy can be conserved.

d. The implementation: Economic analyses and design data for technology projects will be furnished concerning implementation of proposed conservation measures.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $5,633 as follows: FY75 - $191, FY76 - $875, FY77 - $1000, FY78 - $1062, FY79 - $1285, FY80 - $1220. Additional funding will be required for construction and equipment for implementation of identified energy conservation measures. However, an estimate is unavailable due to numerous and varied applications within the ammunition plants.

b. Cost savings will be realized by a reduction in energy expenditures on a process or unit operation basis. Such savings will only be realized when the final recommendations of this project are in fact implemented. The cost of application can not be estimated due to the number and variety of operations investigated by this project.

c. This project will have no adverse effect on the environment nor violate safety standards.

EXH...T P-16 (Part I)
8152

DUPLICATE

AK

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804285 (ARRCOM) 2. PA: 4250 3. Cost: $400

4. Title: MMT: TNT Equivalency Testing for Safety Engineering

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Presently available design criteria for structures which can resist the effects of HE explosions (TM5-1300) is presented in terms of surface bursts of hemispherical TNT. When designing a structure to protect from the blast output of some other energetic material or charge shape, the designer must be able to convert the loading given in the TNT design manual into information which is pertinent for the material in question.

b. The solution: By testing to generate peak pressure and positive impulse data from blast measurements of a variety of high energy materials (propellants and explosives). These results are compared with the blast output of surface bursts of hemispherical TNT in order to determine the TNT equivalency of the material.

c. The end products of this projects are: The actual end products the Government will receive from this project are: TNT equivalencies, design data, test methods and technical reports.

d. The implementation: This data will be submitted through appropriate channels for safety approval and then published in technical reports. Upon approval, the cognizant plants and the COE will be advised of the results so that they can be implemented into facility designs.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $2,581 as follows: FY76 - $325; FY76 "T" Budget - $81; FY77 - $380; FY78 - $400; FY79 - $420; FY80 - $400; FY81 - $375; FY82 - $200.

b. This project is concerned with improved safety. There are no trade-off alternatives, including the inaction alternative, which will meet the irreversible management decisions to provide a high level of safety consistent with the safety echelons determination of "acceptable level of risk." The project therefore appears to fall within the exceptions and do not require a quantifiable economic analysis as given in AR 11-28, para 1.3d(3). DARCOM Suppl 1 to AR 11-28 notes that non-quantifiable benefits will be difficult to justify unless they involve health, safety or security. The non-quantifiable benefits accruing will be increased protection for personnel, equipment and facilities by applying the safety echelon approved safety engineering data derived. Specifically affected will be design criteria for quantity-distance, detonation-propagation, structural and barricade response, and classification involving accidental explosions. Monetary savings may or may not result, dependent on the specific case, but in all cases safer conditions will result.

EXH' P-16 (Part I)
8152

AK

DUPLICATE

DATE: 1 Jun. 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804287 (ARRCOM) 2. PA: 4250 3. Cost: $371

4. Title: MMT: Dev of Detonation Traps f/Improved Safety

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801/Contractor to be selected

6. Summary:

a. The problem: Current and proposed designs of munitions plants require molten explosives, fluidized propellants, explosive slurries and emulsions and explosive fines and dust to be transported through pipelines without sufficient means of preventing a detonation from propagating from one process area to another through the lines.

b. The solution: The development and installation of detonation traps (DT) in the explosive carrying pipelines will serve to prevent a detonation from propagating between process areas. Previous efforts under Project 4134 have resulted in the development of an active DT system, for one inch diameter lines, which has proven successful in arresting high order detonation of molten Comp B. A second, passive trap design concept, for use with single phase explosives such as molten TNT or NG slurries, was successfully tested with TNT for feasibility on a pilot scale. This project will continue the development work to provide a full scale prototype DT system for installation in explosive carrying pipelines.

c. The end products of this project are: (1) A complete prototype detonation trap system (2) Test data and a technical report and (3) A technical data package.

d. The implementation: Implementation to improve safety will be via procurement by GOCO munition plants.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

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7. Economics:

a. Total cost of this project will be $821 as follows: FY80-$371; FY81-$450.

b. The benefits from this project will be improved safety and protection of personnel, building and equipment.

c. The execution of this project will have no significant impact on the quality of the environment or current safety standards.

EXH... f P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

RECEIVED 12 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804288 (ARRCOM) 2. PA: 4250 3. Cost: $758

4. Title: MMT: Explosive Safe Separation and Sensitivity Criteria

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Information is required to upgrade processes and facilities in support of the Army's Modernization and Expansion Program for maximum safety of personnel and equipment against explosion propagation on a cost effective basis.

b. The solution: Tests will be designed for various explosives and explosive end items and the results of these tests will be used to establish:

(1) Safe separation distances for explosives, end items, and in-process materials.

(2) Critical and safe depths of bulk explosives on a convevor or storage vessel.

(3) Sensitivity of explosives at various stages of the manufacturing process to primary and secondary fragment impact.

The Program involves test plan development, testing, test data evaluation and report preparation prior to modifying regulatory documents.

c. The end products of this project are: Data, with safety echelon approval, will be used to modify or supplement present regulatory manuals TM5-1300 and AMCR 385-100.

d. The implementation: Information derived will be included in regulatory manuals (AMCR 381-100 and TM5-1300) after safety approval applied in facility efforts.

5804288

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1977 are available. No significant enviornmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $4,119 as follows: FY76-$600; FY7T-$150; FY77-$600; FY78-$826; FY79-$643; FY80-$700; FY81-$600.

b. This project is concerned with improved safety. There are no trade-off alternatives, including the inaction alternative, which will meet the irreversable management decisions to provide a high level of safety consistent with the safety echelons determination of "acceptable level of risk". The project, therefore, appears to fall within the exceptions and do not require a quantifiable economic analysis as given in AR 11-28, para 1.3d (3). DARCOM Suppl 1 to AR 11-28 notes that non-quantifiable benefits will be difficult to justify unless they involve health, safety or security. The non-quantifiable benefits accuring will be increased protection for personnel, equipment and facilities by applying the safety echelon approved safety engineering data derived. Specifically affected will be design criteria for quantity-distance, detonation-propagation, structural and barricade response, and classification involving accidental explosions. Monetary savings may or may not result, dependent on the specific case, but in all cases, safer conditions will result.

c. This project was extended to FY81 because, based on our past experience, the latest priority list submitted by PMO for Production Base Modernization and Expansion will require funding and time extending beyond FY79.

EXH P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 19

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804298 (ARRCOM) 2. PA: 4250 3. Cost: $450

4. Title: MMT: Evaluation of Hexamine Recycle on HAAP B-Line

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: The effluent from the ammonia column of HAAP's Acetic Acid and Ammonia Recovery Unit (B-Line) has a MOB flow rate of approximately 30,000 GPD, and contains up to 0.5 percent cyclohexamethylenetetramine (hexamine). The presence of hexamine causes considerable problems since it cannot be readily biodegraded. Recent attempts to biodegrade hexamine have resulted in gradual die-off of the bomass shortly after biodegradaion of the hexamine started. The chemical decomposition products of hexamine are formaldehyde and ammonia, both quite toxic to aquatic life and microorganisms. Whether the biodegradability problems are due to toxicity of hexamine itself, or from possible formation of formaldehyde and ammonia, has not been determined.

At present this stream is being discharged, untreated, to the Holston River, but a liquid waste treatment facility is now being designed. In connection with this facility, it is planned to use a wet oxidation unit, which is quite expensive to build and operate, to destroy the hexamine before discharging the stream to the treatment facility.

b. The solution: ARRADCOM, has been studying an alternative to discharge and/or wet oxidation of the 0.5 percent hexamine stream. This alternative is the recycle of the bottom stream from the ammonia column containing the dilute hexamine back to the ammonia scrubber or to the ammonia column feed stream. The hexamine concentration can be built up to from 15 to 30 percent, at which point it can be either reused or easily incinerated. The aqueous effluent can be further purified by scrubbing the remaining ammonia out in a water scrubber, yielding an effluent that is virtually pure water, suitable for use as make-up water.

This work has been evaluated on a bench scale (1/750 of full scale), however, it is important that this process be evaluated on a pilot test basis of much larger scale (1/10 full scale). An evaluation of the modification on this scale would eliminate the need for a more costly prototype evaluation and the information gained would be valid for design of a full-scale plant modification.

5804298

As a result of this project, water pollution would be eliminated (zero discharge would be achieved) while eliminating the need for the wet oxidation treatment to destroy the organics in the effluent. This would result in a savings of approximately $1M to purchase and install the unit, plus about $50K annual operating expenses. In addition, a savings of about $717K can be realized annually as a result of recovering ammonia, methyl amine, and hexamine now being discharged from the plant.

c. The end products of this project are:

(1) Technical reports and technical data detailing pilot operation.

(2) Design criteria for modification of the present acetic acid and ammonia recovery facility (B-line) at HAAP.

d. The implementation: The end product of this effort can be applied to the modernization of HAAP; as well as to the design of the proposed X-Facility.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The funding required for this project is as follows: FY80 - $450, FY81 - $382, for a total of $832.

b. There are both monetary benefits, which result from a very short amortization period and continuing cost benefits after amortization, and non-monetary benefits as a result of conformance to the Federal EPA 1985 deadline for zero discharge.

EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
12 JUN 1978

1. Project No: 5804306 (ARRCOM) 2. PA: 4250 3. Cost: $118

4. Title: MMT: Improved Process Control System for the 105MM M67 Bag Manufacturing System.

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801/Indiana APP, Charlestown, IN

6. Summary:

a. The problem: The bag manufacturing system as installed at Indiana APP has the operated up to desired reliability. Most of the system downtime has been attributed to the sensors and fluidic control system. An ARRADCOM task team and ICI America the operating contractor have cited numerous problem areas: unclean air for fluidics, oil vapors, vibration causing line breakage, clogged sensors due to lint, parts interchangeability, and loop tuning.

b. The solution: The bag manufacturing system will be evaluated and particularly the sensor/control system. An optimum input/output (I/O) requirement will be formulated to control the system in a fail-safe manner. Present fluidic logic diagrams will be converted to ladder-type diagrams. The fluidic control system will be replaced with solid state logic. The use of electronic sensors, particularly photo electrics and fiber optics, will replace a majority of the fluidic sensors for those fluidic sensors which cannot be readily replaced with electronics, pressure to voltage switches (P/E) will be utilized. The cost of explosion proofing the system may be cut significantly through the use of intrinsically circuitry.

c. The end products of this project are:

(1) An improved prototype bag manufacturing machine.

(2) A technical data package that can be utilized to convert the remaining machines.

(3) Operating & Maintenance Instructions

d. The implementation: One bag manufacturing machine will be used as a prototype for this project. This machine will be evaluated and modified as required to upgrade its performance. Simulated and actual production runs will be used to determine the improved performance. The remaining 34 machines will be modified under a subsequent modernization project.

e. The Environmental Impact Assessment: The environmental consequences of), dated 1 April 1978, are assessed, and the approved resulted of the Environmental Impact Assessment, (EIAmental controvery expected to attached. No significant environmental impact is anticipated nor is any environ be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $105 as follows: FY80-$105

b. The benefits resulting from this project will be:

An annual savings of $76.6 realized from a production availability increase and reduced power consumption.

c. Execution of this project will have a beneficial impact on the quality of the environment. A reduction in the usage of electrical power can be realized by converting the present fluidic controls to electronic. The Army's Hygiene & Environmental agency has cited the air systems on the 105MM bag and propellant charge manufacturing prototype facility for causing high noise levels.

EYH1 P-16 (Part I)
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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804309 (ARRCOM) 2. PA: 4250 3. Cost: $1,340

4. Title: MMT: Propellant Process Development for 120mm Tank Ammunition

5. Facility/Contractor: ARRADCOM, Dover, NJ/Radford AAP, Radford, VA

6. Summary:

a. The problem: The German designed 120mm tank ammunition rounds to be manufactured in US facilities will require German developed propellants whose composition and processing differ from standard US propellants and manufacturing techniques. German processing techniques must be transposed into US facilities for mass production of these rounds.

b. The solution: A two year MM&T program will be required to study the transposing of the German compositions and processes into US mass production facilities and practice, including equipment design and modification, hazards analysis, pollution abatement, process evaluation and product qualification. The program will consist of development of techniques for desenitization of DEGDN spent acid, adaptation of German compositions to current solventless propellant manufacturing processes, and development and evaluation of stick take-away/handling equipment and stick drying, cutting and blending operations.

c. The end products of this project are:

(1) A final technical report

(2) Equipment and facility design criteria for processing the German developed propellants

(3) A process facility capable of producing 170,000 lbs of propellant per month

(4) Operating and safety procedures for the process facility

(5) Qualification of the process facility and demonstration of product quality.

d. The implementation: The process facility will be capable of providing 170,000 lbs per month of JA-2 and DIGL-RP propellant. This facility will be located at Radford AAP. A small expenditure ($50.) for additional equipment will expand the capability of this facility to meet FYDP requirements. The results of this project will directly contribute to a Sunflower AAP effort to provide a larger scale facility to fully meet further production requirements.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the environmental impact assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,871 as follows: FY78 - $531 and FY80 - $1,340.

b. The benefits from this project will be:

(1) A capability of meeting initial US peace time requirements for German developed propellant for 120mm Tank Ammunition.

(2) Engineering design criteria for establishing a facility for meeting mobilization requirements and future peace time requirements for German developed propellant for 120mm tank ammunition.

c. Execution of this project will have no significant impact on the quality of the environment.

EXI T P-16 (Part I)
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DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804312 (ARRCOM) 2. PA: 4250 3. Cost: $276

4. Title: MMT: Injection Molding for Production Explosive Loading

5. Facility/Contractor: ARRADCOM, Dover, NJ/contractor to be selected

6. Summary:

a. The problem: This continuing project will complete the development of a process that will eliminate riser scrap when melt loading small caliber munitions. Currently, melt loaded small items (40MM and less) generate a disproportionate amount of riser scrap in relation to the explosive charge. In some cases the riser scrap exceeds the explosive cast. This increases explosive requirements and creates material handling problems in recycling riser scrap.

b. The solution: The purpose of this program is to develop an injection molding process that will be a viable alternative to melt loading of the small caliber munitions. The injection molding system will eliminate the large quantities of riser scrap generated by the current melt-loading of these munitions. The technical and economic advantages of this process will also be defined.

c. The end products of the project are: The results of this PEM Program will be used to define the procedure for melt loading of small caliber ammunition with an injection molding process.

d. The implementation: The results of this project will be used to define the baseline requirements of an automated Injection Molding System for processing small caliber munitions on mass production LAP lines.

e. The Environmental Impact Statement: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The execution of this program will provide a satisfactory process for injection molding small caliber ammunition with high explosives. The utilization of an automated injection molding system vs the present batch system would result in a cost saving of $1376 per year. The Return on Investment (ROI) is 83%. The intangible benefits are (1) increased process efficiency and reduced material handling requirements (2) provide significant improvement in safety due to less personnel exposure and the elimination of human judgement.

b. The total cost of project will be $537 as follows: FY79-$261 and FY80-$276.

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EXH. 8152 P-16 (Part I)

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804313 (ARRCOM) 2. PA: 4250 3. Cost: $280

4. Title: MMT: Dev LAP Tech for Oper Req by Ger 120MM Des Cart

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor (to be selected)

6. Summary:

a. The problem: The West German 120MM Weapons System has been selected for use on the XM1 Tank. At this point, while the West German APFSDS-T, THE MP-T and many other associated 120MM complete rounds such as training Rds etc are being developed, only limited testing has been performed to date. Those Rds produced to date - for testing, have been manufactured strictly in bench or model shop quantities. The present designs are unique and require development of LAP technology prior to establishing a production capability.

It is not known at this point what specific problems will be encountered during production since these rounds have not been mass producted to date. However, some of the problems which may be anticipated are in the following areas:

(1) Assembly of the combustible case to projectile.

(2) Loading of the combustible cartridge is unique and different from normal American practice.

(3) Operations need to be sequenced properly in order to permit orderly and efficient loading and assembly.

(4) Method of loading explosive charge in heat - MP round is unique and required a special facility.

(5) Lethal fragmentation of Heat - MP round.

(6) Gooves on outer diameter of penetrator portion of subprojectiles of Kinetic Energy round is now threaded by Germans - plans are for buttress grooves when we produce the round.

b. The solution: The unique assemblies and loading requirements will be reviewed to formulate appropriate concepts. The concepts will be expanded to bench models to prove feasibility. In conjunction with developing LAP methodology for the present designs, any obvious changes in assembly that will enhance the LAP operation will be recommended to the item engineer.

c. The end products of this project are: This project will result in well defined LAP production facility line layouts. Additionally, the methodology to accomplish to unique operations required by the present designs will be established and demonstrated with bench models.

d. The implementation: The results of this project will be implemented when production lines are established. Costs of establishing these lines will not be borne by this project.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) date 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project is $280 as follows: FY80 - $280. Implementaton costs cannot be defined.

b. The results of this project will result in methodology, possible simplication of design, and a propellant loading operation which is less hazardous than that dictated by the present designs.

EXI I P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 12 JUN 1978

1. Project No: 5804320 (ARRCOM) 2. PA: 4250 3. Cost: $401

4. Title: MMT: Combustible Cartridge Case Process - 120MM

5. Facility/Contractor: ARRADCOM, Dover, NJ 07801/Contractors to be selected

6. Summary:

a. The problem: The West German (GE) method of manufacturing combustible cartridge cases currently being considered for the 120mm R&D Ammunition program uses a solvent system. This solvent is toxic and flammable and will require an expensive solvent recovery system to comply with the appropriate EPA regulations.

b. The solution: The object of this project is to establish an alternate manufacturing process (US) which would eliminate the need for organic solvents. The alternate process will be of the "Beater Addition" type where only water, no solvent, is used. This process is used currently to manufacture 152mm combustible cartridge cases for production. The R&D in this US process was completed on the 152mm case program and no additional R&D process work will be required for the 120mm combustible cartridge case. Since this proposed effort is to establish an alternate manufacturing method to produce the 120mm case, no product improvement is involved.

c. The end products of this project are:

(1) A beater addition (water system) process will be established.

(2) A final engineering report containing test data and recommendation for implementation of manufacturing facility.

d. The implementation: The elimination of the solvent recovery system will reduce the initial cost of plant installation for case manufacture. There will be no recurring cost for solvent recovery since the solvent system will have been eliminated.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An Environmental Impact Statement (EIS) is not required.

7. Economics:

a. The total cost of this project will be $436K as follows: FY80 - $436K

b The benefits resulting from this project will be:

(1) A savings of approximately $780K by eliminating the initial solvent recovery system and attendant cost associated with the GE process.

(2) A GE case will cost $18.82 vs $15.47 for a US process case. The total annual savings will vary with the yearly case production.

(3) Elimination of potential hazards such as fire and the use of toxic materials.

c. Execution of this project will have a significant beneficial impact on the quality of the environment and safety.

EXI T P-16 (Part I) DUPLICATE
8152

AK

DATE: 1 Jun

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

4281

RECEIVED 14 JUN 1978

1. Project No: 5804341 (ARRCOM) 2. PA: 4250 3. Cost: $972

4. Title: MMT: Improved Nitrocellulose Purification Process

5. Facility/Contractor: ARRADCOM, Dover, NJ/Radford AAP, Radford, VA

6. Summary:

a. The problem: The batch purification process for nitrocellulose has remained essentially unchanged since WWI. It requires lengthly boiling and poaching cycles and utilizes large quantities of steam, water and electricity. Studies conducted at Badger AAP and Indiana AAP during the 1950's showed that pressure boiling reduced cycle times significantly, but that it caused excessive viscosity reduction.

b. The solution: This project will evaluate the prototype equipment in the poaching and acid boil operations. The production of pilot lots followed by ballistic evaluation will be made. Facility Design Criteria will be established and the final report will be prepared.

c. The end products of this project are: This project will provide preliminary design criteria for modernized purification facilities, technical report detailing results, hazards analysis, RAM assessment, Quality Assurance Plan and a prototype 2000 lb/hr continuous purification facility.

d. Implementation: This work will be implemented in follow-on facility projects.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Envionmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated not is any environmental controversy expected to be associated with this action. An EIS is not required.

5804341

7. Economics:

a. The project costs are: FY77 - $165, FY78 - $529, FY79 - $742 and FY80 - $972. The total PEM project cost will be $2408.

b. An ROI of 37.4% is anticipated based on modernization of 3 lines. It is estimated that 3 lines at Radford AAP would realize a $2,708,000 annual savings in utilities. Air and stream pollution will be reduced both from nitrocellulose manufacture directly and from the associated steam and electricity generation. An annual savings of $903,000 per line is estimated.

c. No adverse effect on the environment will result from this project.

EXH. 3152 P-16 (Part I)

DUPLICATE

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804414 (ARRCOM) 2. PA: 4250 3. Cost: $205

4. Title: MMT: Auto Proc Control of Solventless Propellant Paste Composition

5. Facility/Contractor: ARRADCOM, Dover, NJ
Sunflower Army Ammuniton Plant, Lawrence, KS
Radford Army Ammunition Plant, Radford, VA

6. Summary:

a. The problem: A continuous automated solventless propellant process has been installed at Sunflower AAP. An on-line composition analysis system is to be purchased as part of the project. The analyses for various constituents of N5, JA-2 and DIGL-RP propellants are required for process control. The time required for the analysis will be approximately 45 minutes rather than 48 hours or more for manual methods. Only limited testing of the equipment will be possible during prove-out of the Sunflower AAP facility and the equipment's ability to analyze for constituents other than N5 propellant will not be demonstrated. The mobilization requirement for N5 propellant has been substantially reduced and other propellants such as XM37 155MM extruded RAP grain and the JA-2 and DIGL-RP propellants for the 120MM gun may be made in the facility. Rapid on-line analysis for in-process control is required for all solventless propellant manufactured at this new facility.

b. The solution: The operation of an accurate, rapid, on-line composition analyzer for the necessary constituents in N5 propellant will be demonstrated under the proveout of the Continuous Paste Preparation Facility Project 5732383 at Sunflower AAP. The equipment will be transferred to Radford AAP under this project for optimization of the analysis required for N5 propellant constituents and for further development of techniques for the analysis of constituents of XM37, JA-2 and DIGL-RP propellants for which there are no current techniques available.

c. The end products for this project are: The end product from the successful completion of this program will include the demonstrated analytical equipment and techniques to perform internal process control analysis for solventless propellants. The time frame for analysis will be consistent with the requirements of a continuous production facility for solventless propellants.

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d. The implementation: Subsequent to the successful design and prove-out of the rapid analytical control system a Tech Data Package (TDP) will be generated for use by GOCO plants producing solventless propellant.

e. The Environmental Impact Assessment: The Environmental consequences of this project have been assessed and the approved Environmental Impact Assessment (EIA), dated 1 Jul 77 is available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $205 as follows: FY80 - $205.

b. The replacement of the slow laboratory analysis system by a rapid, automated analysis-control system in the continuous solventless paste production would result in an annual savings of $304. Another significant factor would be the elimination of the accumulation of large quantities of solventless paste with improper composition requiring reworking.

DUPLICATE

DB

EXH 8152 P-16 (Part I)

DATE: 1 June 1978

RECEIVED 14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804454 (ARRCOM) 2. PA: 4250 3. Cost: $1283

4. Title: MMT: Auto Insp Device Explos Charge Shell (AIDECS)

5. Facility/Contractor: ARRADCOM, Dover, NJ/Non-Government facilities to be selected

6. Summary:

a. The problem: The Production Base Modernization and Expansion Program for Army Ammunition Plants includes the requirement for high rates of inspection of 155mm XM795 and M549, 8 inch XM650 and HE tank projectiles to detect critical cavitation defects. Currently, the only available method is conventional film radiography which is characterized by prohibitively high cost for X-ray film and personnel, and by the questionable reliability of human interpretation. In addition, film radiography has not shown adequate sensitivity for small base separations in certain high muzzle-velocity projectiles, e.g., XM795.

b. The solution: It is proposed that a filmless, real-time, automated system be developed for inspection of the explosive load in the 155mm XM795, 8 inch XM650, and HE tank projectiles. The basis of the system will be:

(1) Nondestructive examination method using a gamma ray beam, scanning the shell, and measuring scattered radiation. These concepts and technology were developed under prior years Materials Testing Technology (MTT) efforts directed at the 105mm M1 projectile which resulted in an engineering model of the AIDECS system for inspection of that shell.

(2) Previous years Manufacturing Methods & Technology programs (follow-on to the MTT) whose end product is a prototype production AIDECS modules for examination of the 155mm HE RA M549 projectile.

(3) The budget year activity will emphasize the following areas:

(a) Establish techniques and modify AIDECS design to improve sensitivity for detection of base separation in the XM795 projectile. The metal parts configuration makes the defect more difficult to perceive than in the projectiles which have previously been addressed.

(b) Engineering and fabrication of an AIDECS production module which will be readily adaptable to inspection of the 8 inch XM650, the 155mm XM795, or the 155 M549 projectile. This system will eliminate the necessity for having a single-purpose design for each of the shell enumerated.

(c) A study will be made regarding the use of electronic X-ray sources in place of the present cobalt-60 gamma ray sources. This change would result in simplification of safety and licensing procedures as well as eliminate periodic replacement of the decayed source.

(d) The prototype production AIDECS module for the M549 projectile which was completed as part of previous years MM&T activity will be retro-fitted with the capability to inspect the 155mm M549, the 155mm XM795, or 8 inch XM650 projectile. The techniques for increasing sensitivity to base separation in the XM795 will also be incorporated.

c. The end products of this project are:

(1) Technical report on the design of AIDECS system adaptable to M549, XM795, or XM650, including improved base sensitivity detection.

(2) Prototype production module of the system reported.

(3) A previously fabricated AIDECS module for the M549, now retro-fitted for adaptability and improved base separation detection.

(4) Technical report on feasibility of substituting X-ray generators for radio-active Co-60 sources.

d. The implementation: Procurement of additional AIDECS modules, to meet inspection requirements for projected production, will be accomplishmed by funding obtained through facilities projects.

e. Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 30 January 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost for this project will be \$3149; FY78-\$1288; FY79-\$378; FY-80\$1283; FY81-\$200.

b. Non-quantifiable benefits include increased safety, reliability, and performance levels of the artillery shell addressed by this project. Substantial savings are indicated by the economic analysis. Average cost savings for radiographic film exceeds two million dollars per year. Savings/Investment Ratio equals 2.58

c. Performance of this project will have no adverse affect on the environment, and will not violate any safety standards.

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EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5804474 (ARRCOM) 2. PA: 4250 3. Cost: $200

4. Title: MMT: Dehumidified Air for Drying Single-Base Propellant

5. Facility/Contractor: ARRADCOM, Dover, NJ/Radford AAP, Radford, VA

6. Summary:

a. The problem: The present method for drying solvent-type single-base propellants is to force heated air through a bed of propellant granules to remove excess moisture. The air is exhausted to the atmosphere after one pass through the propellant and the excess applied thermal energy is wasted. During periods of wet weather the drying time is significantly longer than during periods of low humidity.

b. The solution: Relatively high efficiencies have been experienced at Radford AAP in drying M1 single-base propellant in the laboratory by the use of recycled dehumidified air. In the production operation an appreciable reduction in steam requirement can be expected from utilizing humidity controls and heat recovery equipment. This project will establish equipment and methods for drying solvent-type single-base propellants with dehumidified air in combination with reduced heat application for effecting a cost reduction and energy conservation in the manufacturing process.

c. The end products of this project are:

(1) Prototype equipment for drying single-base propellant with dehumidified air in a single air drying tank.

(2) A final engineering report containing test data and a thorough technical and economic assessment of the project.

(3) Engineering design and criteria for implementing the air drying of solvent-type single-base propellants using dehumidified air.

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d. The implementation: Subsequent action to the successful completion of this project will be the purchase and installation of equipment in existing batch facilities for conversion to the use of dehumidified air for drying solvent-type single-base propellants. An important related aspect of this project is that the technology developed will be directly applicable to the CASBL which uses substantial amounts of heated air (180°F) in its present propellant drying operation. Conversion to a dehumidified air system would save approximately 80% of CASBL steam costs.

e. The Environmental Impact Assessment: The environmental consequences of this project, have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $550 as follows: FY79 - $350 and FY80 - $200.

b. The benefits resulting from this project will be:

(1) A savings of $881K and an ROI of 20%.

(2) An appreciable reduction in energy consumption with a corresponding reduction of pollutants escaping to the atmosphere.

c. Execution of this project will have no adverse effect upon the environment or violate safey standards.

with heated air at Radford

listed in the FYDP-POM

5804474

EXF 'T P-16 (Part I)
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DATE: 1 Jl 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 12 JUN 1978

1. Project No: 5804492 (ARRCOM) 2. PA: 4250 3. Cost: $270

4. Title: MMT: Water Deluge System Application in Munition Plants

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be determined

6. Summary:

a. The problem: The TM-5-812-1 Fire Prevention Manual has characterized all propellants, explosives, and pyrotechnic fires into one group as Extra Hazard. In Table 2-2.1 (A) of NFPA Bulletin No 13, water supply requirements for Extra Hazard are stated as "Pressure and flow requirements for sprinkler and hose streams to be determined by authority having jurisdiction." The maximum fire extinguishment requirements referenced on page 13-20 of NFPA Bulletin No 13 specifies for a minimum area of application (3000 sq ft) a flow rate of 0.35 gpm/ft^2 over a 60-120 minute duration. No specific criteria is cited for Extra Hazard. In practice, extinguishment of these types of fires must occur in a very short time frame to prevent a potential deflagration to detonation reaction. Indiana and Radford AAP tests have demonstrated that the information furnished by this manual would not extinguish M-1 propellant fires that occurred in accumulators, hoppers, or enclosed conveyor lines. Tests have confirmed that fire extinguishment requirements cannot be extrapolated from one propellant, explosive or pyrotechnic fire to another where quantity, configuration, degree of confinement, and the chemical and physical properties of the base materials differ.

b. The solution: A water deluge system will be developed to extinguish Composition A-5, Cyclotol, M-30, M26E1 and M-10 fires before a transition from deflagration to detonation can occur. A systematic approach will be used to establish the fire extinguishment parameters for each type fire under different quantities of material, degrees of confinement, geometries, height of water application, line pressure, and nozzle variations.

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c. The end products of this project are: Fire extinguishment data will be furnished for the development of a water deluge system for Composition A-5, Cyclotol, M-30, M26E1, and M-10 propellant fires. This information as well as prior fire extinguishment data for propellants, explosives, and pyrotechnics will be incorporated into the TM-5-812-1 Fire Prevention Manual.

d. The implementation: The fire extinguishment data derived from this program can be utilized by the Corp of Engineers in the modernization of old or new plant construction where the manufacture loading or storage of Composition A-5, Cyclotol, M-30, M-26-1 or M-10 propellant occurs.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and approved results of the Environmental Impact Assessment (EIA) dated 1 July 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The funding for this project is as follows: FY79 - $300, FY80 - $270. The total cost of the program is $570.

b. This project is concerned with improved safety and has been specifically requested by the Project Manager for Production Base Modernization and Expansion. There are no trade-off alternatives including the inactive alternative, which will meet the irreversible management decisions to provide a high level of safety consistent with the safety echelons determination of "acceptable level of risk." The project therefore appears to fall within the exceptions and does not require a quantifiable economic analysis as given in AR 11-28, Para 1.3d (3). DARCOM Suppl to AR 11-28 notes that non-quantifiable benefits will be difficult to justify unless they involve health, safety, or security. The non-quantifiable benefits accruing will be increased protection for personnel, equipment and facilities by applying the safety echelon approved safety engineering data derived. Specifically affected will be design criteria for quantity-distance, detonation-propagation, structural and barricade response, and classification involving accidental explosions. Monetary savings may or may not result, dependent on the specific case, but in all cases safer conditions will result.

EXHI 8152 P-16 (Part I)

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804493 (ARRCOM) 2. PA: 4250 3. Cost: $410

4. Title: MMT: Design Parameters for Large-Scale Process Vessels

5. Facility/Contractor: ARRADCOM, Dover, NJ/various supporting Government Agencies-Private Contractors

6. Summary:

a. The problem: At present, Indiana Army Ammunition Plant requires information for the 5000-lb hoppers located in the bay loading operation. Design criteria to prevent a potential explosive hazard in a large scale propellant processing vessel has not been established. When a fire occurs in a process vessel, containment of the combustion gases can cause a pressure rise rate that can culminate in a detonation. This deflagration to detonation reaction, that is dependent on the pressure rise rate is contingent upon the inherent sensitivity of the material and degree of confinement within the vessel. Only a limited analysis for vent ratios in process vessels has been explored. Class 7 operations require the construction of costly facility safeguards. Reclassification of Class 7 to less expensive Class 2 operations cannot be made for process vessels without this information.

b. The solution: Pressure rise rates for different vent ratios in various scaled model process vessels will be recorded. The information obtained will be programmed into the design of a mathematical model. To validate the equation derived from the tests, full-scale tests will be conducted. Thus, for any intermediate size propellant vessel, the proper vent ratio can be predicted.

c. The end products for this project are: A design to prevent a deflagration to detonation reaction in a large-scale propellant vessel will be developed. In addition, a mathematical model that can predict the proper vent ratio for a propellant vessel will be validated. The data furnished for the standardization of design criteria will encompass :

(1) Burning rate versus pressure data for single, double, and multi-base propellants.

(2) Degree of confinement and venting with respect to physical properties, formulations, configuration and vessel size.

(3) Vent ratio requirements to prevent a deflagration to detonation reaction.

All the information generated will be finalized into a technical report and technical data package.

d. The implementation: The design criteria for future propellant process vessels will be furnished to the Corp of Engineers in the form of a technical data package for application in new plant construction.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The funding for this project is as follows: FY79 - $410, FY80 - $410. The total planned requirement is $820.

b. This project is concerned with improved safety and has been specifically requested by the Project Manager for Production Base Modernization and Expansion. There are no tradeoff alternatives including the inactive alternative, which will meet the irreversible management decisions to provide a high level of safety consistent with the safety echelons' determination of "acceptable level of risk". The project therefore appears to fall within the exceptions and does not require a quantifiable economic analysis as given in AR 11-28, Para 1.3d (3). DARCOM Suppl 1 to AR 11-28 notes that non-quantifiable benefits will be difficult to justify unless they involve health, safety, or security. The non-quantifiable benefits accruing will be increased protection for personnel, equipment and facilities by applying the safety echelon approved safety engineering data derived. Specifically affected will be design criteria for quantity-distance, detonation-propagation, structural and barricade response, and classification involving accidental explosions. Monetary savings may or may not result, dependent on the specific case, but in all cases safer conditions will result.

EXH T P-16 (Part I) DUPLICATE
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MC

DATE: 1 Ju. 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804498 (ARRCOM) 2. PA: 4250 3. Cost: $584

4. Title: MMT: Dev Meth for Consol & Auto Assy of Small Mines

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected

6. Summary:

a. The problem: Small mines are new items requiring a first generation of mechanized assembly equipment to meet planned mobilization requirements. Off-line operations on-line inspections and mulitiple handling is required for the predominately manual LAP operations.

b. The solution: A study will be made of the LAP procedures for each of the 3 mine systems (RAAM, GEMSS, GATOR) to determine the extent of automation for each operation. A technical review will be conducted after the study phase before initiating detail design. Prototype equipment will be developed, built, installed, and proved out at Iowa AAP.

c. The end products of this project are: This project will provide technical data packages, LAP process procedures, automated inspections and prototype equipment for the LAP operations.

d. The implementation: Acceptance testing and implementation will be at Iowa AAP.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 Jul 76 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

5804498

7. Economics:

a. Total project cost is estimated to be $2,056 to be funded as follows: FY78 - $325, FY79 - $1,147, FY80 - $584. These costs include installation and implementation at the selected GOCO facility.

b. This project will not have an adverse effect on the environment or violate any safety standards.

EXH\ 8152 P-16 (Part I)

DUPLICATE

1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804508 (ARRCOM) 2. PA: 4250 3. Cost: $500

4. Title: MMT - Process Improvement of Pressable RDX Compositions

5. Facility/Contractor: ARRADCOM, Dover, New Jersey
Holston Army Ammunition Plant, Kingsport, TN

6. Summary:

a. The problem: The present methods for the production of pressable RDX compositions necessitate the use of facilities which will be required for the manufacture of Composition B during mobilization. Due to this restraint a limitation in the production capacity for both Composition B and the pressable RDX compositions exists. This production level is inadequate for meeting current mobilization requirements.

b. The solution: This project will generate complete design criteria for incorporation facilities with processes sufficiently adjustable for the manufacture of pressable RDX compositions (A-3, A-4, A-5) at mobilization levels. This project will include the investigation of present methods of incorporating RDX into pressable compositions as well as applying new technology to coating, drying, and finishing RDX compositions. Applicable to this project is information gained in the development of the continuous production of Composition A-7 (Line 1) and the preliminary investigations carried out on Project 57T4252 and 5774252, and at the ARRADCOM RDX/HMX pilot plant.

c. The end products of this project are: The end result will be a final technical report containing all the results gained from this project and sufficient engineering information to design new improved production facilities and a complete description of new methods, equipment, and technology for processing these explosives.

d. The implementation: In order to gain the benefits of this project the proposed changes will have to be implemented into production at Holston AAP or on Line 2 at the new RDX/HMX facility.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,157 as follows: FY78 - $300; FY79 - $357: FY80 - $500.

b. The benefits resulting from this project will be improved product quality, decreased unit cost, safer operation, and increased process efficiency. A more efficient process design will release equipment currently required for these explosives for the production of other products.

c. N/A

EXH P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5806736 (ARRCOM) 2. PA: 4250 3. Cost: $287

4. Title: MMT, Tech Readiness Accel thru Computer Integrated Mfg (TRACIM) CAD/CIM

5. Facility/Contractor: ARRADCOM, Dover, NJ and contractors to be selected

6. Summary

a. The problem: The lead time required to bring ammunition production (PEP) lines up to mobilization maximum is intolerably excessive. This is attributable, to a large degree, to non-availability of manufacturing technical skills, including engineers, technicians and particularly toolmakers, and machinists. The Department of Labor forecasts the critical shortage of toolmakers and machinists will be almost twice as serious by 1980. Additional and significant delay factors include the readiness of complete and up-to-date data on the item description, manufacturing processes, tool designs, equipment, facilities, machine spare parts, material requirements essential personnel.

b. The solution: It is not expected that the technical skills shortage will ameliorate and is more likely to grow much worse. The development and implementation of a Computer Integrated Manufacturing (CIM) System involving interactive graphics and numerical control machine tools will significantly reduce the requirement for highly skilled manufacturing craftsmen. Also, a computer data bank based on Group Technology techniques and maintained in a ready status will provide management and engineers immediate access to the very latest data required for a rapid build-up to maximum planned schedules.

c. The end products of this project are: A comprehensive Computer Integrated Manufacturing (CIM) System will be developed and demonstrated on samples of ongoing metal parts and items in the planning stage. The system will be suitable for application to the entire spectrum of ammunition design/manufacture.

d. The implementation: Introduction of the techniques generated by this project will significantly cut lead time for active and mobilization PEP lines. TRACIM is a total technology which will require an extended time for complete realization and involve significant changes from conventional approaches to manufacturing. However, short term phases will be developed, demonstrated and made available for installation. The second and third year efforts are planned to accomplish these objectives. Fourth and future year efforts will provide the necessary modification and expansion of TRACIM for technology transfer and application to all aspects of ammunition systems engineering and manufacturing.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. This is a four year project totaling $683. PEM project funding for FY is summarized as follows:

FY76	Prior FY78	FY79	Present FY80
40	100	256	287

NONMETALS PROGRAM

FY80 NON-METALS PROJECTS
08/02/78

PROJECT NUMBER	TITLE	COST
D 80 5052	Army Engineering Design Handbooks for Production Support	460
E 80 3704	Lightweight Collapsible Potable Water Hose	280
E 80 3708	Coated Fabric Collapsible Fuel Tank Program - Circular Seaml	150
E 80 3709	Continuous Length Fuel Hose	329
E 80 3717	High Temperature Turbine Nozzle for 10 KW Power Unit	400
E 80 3747	Lighter, LACV-30, Skirt and Finger Components	191
Q 80 8063	Improved Methods of Manufacture of Butyl Rubber Handwear	672
Q 80 8065	Kevlar/Nylon Orthogonal Fabrics in the Helmet and Vest	250
Q 80 8066	Continuous Filament Helmet Preform	500
R 80 1026	Low Cost Manufacturing Technology for the High Production of Missile Vanes	255
R 80 3142	Production Methods for Low Cost Paper Motor Components	200
R 80 3219	Automatic Polymer Attachment Production Methods	200
R 80 3280	Manufacturing Parameters for Thermal Batteries	240
R 80 3396	Injection Molding of Low Cost - One Piece Nozzles	180
R 80 3449	Opt Prop Ingred to Replace Potential Toxic Materials	150
T 80 4264	Track Inserts and Fillers for Track Rubber Pads (Phase II)	125
T 80 4389	Production of Foldable Plastic Tops for Soft Top Truck Cabs	150
T 80 5007	Advanced Technology Brake Lining Materials (Phase II)	190
T 80 5019	Storage Battery, Low Maintenance - Phase III	290
T 80 5045	Spall Suppressive Armor for Combat Vehicles (Phase II)	190
T 80 5065	Advanced Technology Surveillance Countermeasure Materials	190
T 80 5067	Plastic Battery Box (Phase II)	60
T 80 5068	New Anti-corrosive Materials and Techniques (Phase I)	200
T 80 5075	Military Elastomers for Track Vehicles (Phase I)	200
T 80 6000	Lightweight Tilt-up Hood Fender Assembly (Phase II)	350
1 80 7113	Composite Rear Fuselage Manufacturing Technology	1350
1 80 7119	Non-destructive Eval Techniques for Composite Structures	400

FY80 NON-METALS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
1 80 7183	Semi-auto Composite Manufacturing System Helicopter Secondary Structure	355
1 80 7198	Composite Material Engine Accessory Gearbox Housing	440
1 80 7200	Composite Engine Inlet Particle Separator	550
1 80 7202	Application of Thermoplastics to Helicopter Secondary Structures	275
1 80 7243	Machining Operations on Kevlar Laminated Constructions	125
1 80 7288	Determination of Optimal Curing Conditions for Composites	325
1 80 7294	Composite Apex Fitting for Army Aircraft Sling Applications	100
1 80 7299	Production of Low Cost Thermoplastic Prepreg	300
1 80 7301	Filament Winding Process Fabrication of Non-straight Tubular	95
1 80 7302	Production of Boride Coated Long Life Tools	200
1 80 7315	Stabalized Line or Sight Gimbal Production	150
1 80 7338	Composite Tail Section	875
1 80 7339	Filament Wound Composite Flexbeam Tail Rotor	1385
1 80 7340	Composite Main Rotor Blade	2950
1 80 7341	Structural Composites Fabrication Guide	85
1 80 7342	Pultrusion of Honeycomb Sandwhich Panels	150
1 80 7344	Rim Urethane Molding for Low Cost Secondary Structures	150
1 80 7345	In-process Control of Resin Matrix Cure	250
5 80 1001	Pilot Line for Fuze Fluidic Power Supplies	250
5 80 1345	Manufacturing Methods and Technology for the Biological Warning System	450
5 80 4062	Auto Manufacture System for Mortar Increment Containers	1100

FY80 NON-METALS PROJECTS, 08/02/78, Continued

PROJECT NUMBER	TITLE	COST
5 80 4190	Molding Rear Seal, 120mm Frg, APFSDS, Projectile	384
5 80 4258	Solar Ponds/Heat Pumps to Deliver Hot Process Water	215
5 80 4281	Conservation of Energy at Army Ammunition Plants	1220
6 80 7940	Synergistic Platings with Infused Lubricants	120
6 80 8001	Rapid Flow Plating of S all Caliber Gun Tubes	130
6 80 8004	Co-deposition of Solid Lubricants During Anodizing	120
6 80 8017	Pollution Abatement Program	171
6 80 8026	Application of Synthetic Quenchants to Gun Tubes	141
6 80 8030	Manufacturing Guide for Elastomeric Seals	100

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

EXHIBIT P-16 (Part I) | RCS CSCRD-165 (R1) | Date: 25 July 1978

1. Project No.: D 805052 (DARCOM) 2. PA 5397 3. Cost: $460,000

4. Title: MM&T: Army Engineering Design Handbooks

5. Facility/Contractor: Research Triangle Institute, North Carolina

6. Summary: (a) Problem: No other existing Army program or mechanism provides for the initiation, revision, and updating of technical, scientific, and engineering data used in production and procurement of military hardware, software, and equipment within the short timeframe established by this effort. (b) Solution: The goal of this project is to provide new, revised and updated technical and scientific data used in production and procurement of military hardware and equipment. It will collect, tabulate, and provide up-to-date scientific and technical guidance for engineering, production, and fabrication of Army hardware (equipment and components) in support of Army programs. (c) End Products: The end products of this project will be software, manuscripts of technical, scientific, and engineering data compiled in handbook format to facilitate distribution and use. Table 1 is a listing of the current DARCOM Engineering Design Handbooks. (d) Implementation: Implementation will take place by delivering Camera Ready Copies (CAREC) of manuscripts to the Commander, DARCOM, DRXAM-ABE, for printing and binding. Distribution to Army activities will be made from Letterkenny Army Depot, to other DoD elements via the Defense Documentation Center and to industry via the National Technical Information Service. Point of contact is Paul Wagner, AUTOVON 793-4041.

7. Economics: This project will provide for the timely dissemination of new technology so that consistent reproducibility can be realized years before it can be documented in text books or other media. Monetary savings associated therewith are admittedly difficult to assess accurately, but can be identified in any item of Army hardware. For example, four previous volumes devoted to the helicopter series are estimated to result in a conservative 15% savings in the $1.5 billion five-year procurement. This figure, $225 million, represents a sizeable cost savings on one principal item alone. Procurement summary expenditures for FY 77-FY 79 will approximate $1.3 million. Projected procurement expenditures for FY 80 will approximate $460,000; and FY 81-FY 83 approximates $1.4 million. The execution of this project will not have significant impact on the quality of the environment. See Table 2 for details of FY 79, 80 & 81 Engineering Design Handbook (EDH) Program plan.

DUPLICATE

Exhibit P-16 (Part I)

RECEIVED 3 MAY 1978

DATE: 1 May 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

1. Project Number: E803704   2. PA: 5397   3. Cost: $280K
4. Title: MM&T - Lightweight Collapsible Potable Water Hose
5. Facility/Contractor: US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, Virginia/Contractors to be selected through competitive negotiation.
6. Summary:

(1) Problem - Specially lined, cotton, single jacketed fire hose is being used in water purification systems. This hose has poor abrasion resistance and, in the presence of moisture, the fabric weakens rapidly due to mold and mildew. The hose deterioration, due to abrasion and mold/mildew, causes unnecessary expense in procurement and associated logistics, and the requirement to dry the hose thoroughly before packing hampers rapid mobility.

(2) Solution - The solution is to develop the technology necessary to manufacture single jacketed polyester hose with suitable all weather, abrasion resistant, external lining and an inner lining which is acceptable to the Surgeon General for potable water use.

(3) End Products - This project will result in technical reports, economic analysis, manufacturing technology and prototype hardware to enable the Army to select and procure an improved replacement for current water hose.

(4) Implementation - Implementation will be accomplished by writing a military specification based upon the project end products, and using this specification to procure polyester hose in the appropriate sizes for future issue with water purification equipment and as replacements for unserviceable cotton lined hose.

Technical POC: 1LT Ernest D. Smith - AUTOVON 354-5172

7. Economics:

(1) The costs of the program (in base year FY77 inflated IWA DARCOM Letter, DRCCP-ER 30 Sep 77, subject: Inflated Guidance) are:

			Future Years (Inflated)		
Appropriation	Prior Year	Current Year	FY1979	FY1980	FY1981
OPA	0	0	0	280K	512K
RDT&E	0	0	0	0	0

(2) There are non-monetary benefits which result in a product which requires less time consuming care, improved transportation and storage characteristics, and preparation of the military to meet future needs now being developed for highly mobile water supply and distribution equipment.

(3) The execution of this project will have no affect on the environment and will not violate safety standards.

EXHIBIT P-16 (PART 1) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE: JUL
ROC CSGLD-1125(R1)

DUPLICATE

1. Project No.: E803708 2. PA: 5397 3. Cost: 150K
4. Title: MM&T - Coated Fabric Collapsible Fuel Tank Program - Circular Seamless Weaving.
5. Facility/Contractor: Contractor effort for this project will be selected through competitive negotiations. MERADCOM, Fort Belvoir, Virginia has the responsibility for supervision and control of the total effort.
6. Summary: (Technical POC: Mr. Browne, AUTOVON 354-5781)

a. Problem: At present, most suppliers of collapsible fuel tanks use the manufacturing technique of seaming together fabric panels in order to construct the large envelope required for "pillow tanks". The seams are known to be the weakest link in tank construction; seam separation is the most common catastrophic type failure. In addition, the fabrication of seams requires considerable time and manpower. Much of the work is done by hand and the vulcanization requires from 1 to 3 hours cure time in the plattens per seam.

b. Solution: The manufacturing methods of collapsible tanks can be improved by developing a weaving technique which will produce a circular, seamless tube. It will only be necessary to seam two end closures to complete the tank envelope.

c. End Products: This MM&T project will generate weaving techniques which will be applicable to all sizes of collapsible fuel tanks, but will be of special importance to the larger capacity high stress tanks.

d. Implementation: This MM&T project will permit the development of a manufacturing method to produce a woven seamless tube (or sleeve) for construction of collapsible fuel tanks. Implementation can be achieved by changing the specification for standard size collapsible tanks to require seamless fabric construction for the purpose of obtaining a more uniform and reliable product. For larger sizes of tanks, subjected to high stresses, development of seamless weaving techniques is imperative in order to provide the necessary structural integrity.

7. Economics: a. The estimated cost of this program is (in K dollars).

	Prior to FY80	FY80	FY81	FY82	FY83
R&D	2,035		-		
OPA	97	150	--	--	--

b. Savings can be realized by producing a more uniform product, with less reliance on hand labor in the critical area of seam construction. A seamless sleeve tank will exhibit longer life and higher reliability than conventional tanks. Savings can also be realized in fabrication time by eliminating the need to vulcanize each longitudinal seam. Estimated savings is $1000 each for the 50,000 gallon-size tanks.

c. The anticipated project will have no adverse effect on the environment.

E803708 (MERADCOM)

DUPLICATE

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD - 1125 (R1)

DATE: 1 - JUL 1978

1. Project No: E803709 (MERADCOM) 2. PA: 5397 3. Cost: 329
4. Title: (MM&T) - Continuous Length Fuel Hose
5. Facility/Contractor: Contractor effort for this project will be selected through competitive negotiations. MERADCOM, Fort Belvoir, Virginia has the responsibility for supervision and control of the total effort.
6. Summary: (Technical POC: Mr. Browne, AUTOVON 354-5781)

a. Problem: Specification MIL-H-52262A(ME) describes 4-inch hose to be supplied in lengths of 500 feet between couplings. These "continuous" (500 foot) lengths of hose are currently fabricated by splicing and vulcanizing together 50 foot sections. This results in very high cost. In addition these splices add considerably to the bulk of the hose and add to the difficulty of playing out the hose from trucks in the field.

b. Solution: The manufacturing problems can be resolved by modifying an existing technique used for manufacture of continuous, non-spliced lengths of irrigation hose.

c. End Products: This MM&T project will generate manufacturing techniques for producing much less costly hose to MIL-H-52262 and other continuous-length hoselines.

d. Implementation: In addition to the current method of manufacturing continuous lengths of irrigation hose, other possible fabrication methods will be reviewed. A contract will be awarded to modify an existing procedure or to develop a new technique. Construction of a pilot installation may be necessary. Availability of a method of making 500-foot lengths would have saved $125,000 in the proposed pilot procurement of 2.5 miles of hose.

7. Economics:

a. The costs of this program in thousands of dollars are (estimates are base year FY78 inflated in accordance with DARCOM Letter, DRCCP-ER, 28 December 1977, subject: Inflation Guidance):

	Prior to FY80	FY80
R&D	631	--
PEM	260	329

b. The effort is to develop a cheaper method of manufacturing continuous lengths of hose. This method would eliminate the costly splices which add problems with regard to installation in flaking boxes. The estimated cost reduction form the present hose is $50,000 per mile of hoseline. Procurements scheduled by TROSCOM over the next 5 years include 90 systems (2½ miles of hose per system) for a savings potential of over $10,000,000.

c. The anticipated project will not have any adverse effects on the environment but rather will decrease the chance of hose rupture by eliminating splices.

PRODUCTION ENGINEERING (SURES (PEM) PROJECT
RCS CSCLD

DUPLICATE

1. Project No.: E803717 2. Code: 5397 3. Cost (Thou): $400
4. Title: MM&T, High Temperature Turbine Nozzle for 10KW Power Unit
5. Facility/Contractor: The contractor for this project will be the same as the contractor selected for the project initiated in FY78 (Project E783717). The contractor will be a manufacturer of small gas turbines i.e. Solar Turbines International, San Diego, CA with principle subcontractors as suppliers of ceramic components. Primary Agency responsible for this effort is MERADCOM, Fort Belvoir, VA.
6. Summary:

a. Problem. Life and performance of small radial gas turbines, such as the MERADCOM 10KW unit are limited by the turbine nozzle. Life is further limited when operating under dust and errosive conditions and may be only 1-10% of the planned life. Performance is limited by the max metal temperature of 1750°F. The replacement of super alloy nozzles with silicon-based ceramics can provide 10-100 times the life of the metallic nozzle under adverse operating conditions based on R&D evaluation of handmade ceramic components. The benefit of turbine power increase and improved cycle efficiency can be realized by increasing turbine inlet temperature (T.I.T.) about 1800°F as limited by superalloy components while conserving strategic materials. Manufacturing methods must be established to reduce the cost of production ceramic components.

b. Solution. The manufacturing problem can be resolved by applying new production processes and techniques to reproduce parts of required quality and uniformity while reducing hand labor operations and final machining requirements. These methods will reduce component costs now required in "laboratory like" fabrication. The projected cost reduction should provide a unit cost of reproducable components at least 1/5 the present prototype unit cost.

c. End Products. Three major end products will result:
1. A "hardened" 10KW power unit able to operate in a sand and dust environment at reduced cost.
2. An uprated turbine consisting of ceramic nozzle and metallic wheel w/T.I.T. of 1950°F and outputs of 15KW.
3. Manufacturing technology for ceramic nozzles for the small 10KW engine applicable for larger unit i.e. UTTAS helicopters.

d. Implementation. The successful completion of this project will result in an economical process for fabricating a ceramic turbine nozzle for the hardened and uprated high temperature radial gas turbine application. Project Engineer: James P. Arnold, AV354-5459.

7. Economics:

a. Planned expenditure for this project (in thousands) are summarized:

	PRIOR	FY80	FY81
RDT&E			
OPA	343	400	400

b. The effort is to produce a ceramic turbine nozzle that will withstand an erosion and corrosive environment, an increased turbine inlet temperature and be suitalbe for mass production.

c. The anticipated project will not have any adverse effects on the environment nor will it violate safety standards.

DUPLICATE

EXHIBIT P-16 (Part I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE: 1 JUL 1978

RCS CSGLD 1125 (RI)

1. Project No. E803747 (MERADCOM) 2. Code: 5397 3. Cost (Thou): $191

4. Title: MMT - Lighter, Air Cushion Vehicle (LACV-30), Skirt & Finger Components.

5. Facility/Contractor: Contractor/facility project will be selected thru competitive negotiation. MERADCOM has the responsibility for supervision and control of the total effort.

6. Summary: a. Problem. A major replacement cost factor associated with employment of ACVs is replacement of air cushion skirt & finger components. Current state-of-the-art allows 300-400 hrs operation before required replacement due to damage caused by wear & flagellation. Since 350-400 fingers & hundreds/sq ft skirt make up a typical ACV, significent savings are accrued if component production costs can be lowered. Currently, the hand fabrication of these components is highly labor intensive, thereby keeping replacement costs high. Inasmuch these components presently cost approx. $60 each, and are replaced every 400 hrs, reduction of fabrication costs can result in significant savings.

b. Solution. State-of-the-art mechanized and automated fabrication techniques will be used to reduce manufacturing costs. Among techniques to be used to reduce hand labor are: press cutting material in lieu of hand cutting, bonding material in lieu of hand stapling, bonding and/or molding of hardware in lieu of hand mechanical attachments.

c. Implementation. This project will generate mfg techniques/processes to reduce cost of fabricating skirt & finger components. Based on BOIP (75-0085011) & prelim. proc. planning, there will be a min. of 30 ACV-30 systems, each system having 400 skirt fingers; i.e., 12,000 fingers will be procured. These would normally be replaced once/yr (max 400/hrs life) & 15 times over projected 15 /yr life cycle. At $20 per skirt finger, total present value of savings is $1.318 million.

d. Point of Contact for this project is: Frederick DeFilippis, AV 354-5802

7. Economics: a. The costs of this program in thousands of dollars are:

Appropriation	Prior Yr (Actual)	Current Yr (Actual)	Future Yrs (Inflated/Then Yr) FY79	FY80	FY81
OPA	0	0	0	191	120
RDT&E	0	0	0	0	0

(Estimates are base year FY78 inflated in accordance with DARCOM Letter, DRCCP-ER, 28 December 1977, subject: Inflation Guidance)

b. Effort is to produce acceptable ACV skirt fingers & components utilizing mechanical and automated production processes which will eliminate hand fabrication. Estimated cost reduction should be from a present cost of $60 to $40 per skirt finger.

c. The execution of this project will not have a significant impact on the quality of the environment nor will it violate safety and health standards.

Project No. E803747 (MERADCOM)

Exhibit P-16 (Part 1) DATE: 1 July 1978

Production Engineering Measures (PEM) Project

1. Project No: Q808063 (NARADCOM) 2. OMA 728012.12 3. Cost (MIL): 0.510

4. Title: MM&T - Improved Methods of Manufacture of Butyl Rubber Handwear

5. Facility/Contractor: Private contractors, NARADCOM, and CSL

6. Summary:
a) The Problem: The present method for the manufacture of the butyl rubber gloves is by multiple dipping of ceramic molds into a solution of butyl rubber dispersed in organic solvents. This process is slow, hazardous, and requires close quality and environmental control. The Safety Products Division of the Norton Company is the only producer for butyl gloves for all US Government needs. The Government is placed in the unattractive position of procuring butyl gloves from a sole source. This sole source cannot produce enough gloves to meet current or future military needs. b) The Solution: (1) Injection Molding: Gloves produced by this method could be made in minutes rather than hours and would provide alternative sources of supply and may offer greater protection and durability. (2) Aqueous Latex Dipping: This method can be used to produce gloves equal to those made by the solvent system, eliminate the solvent hazard and provide alternate sources of supply.
c) End Products: Gloves, production formulations, techniques of manufacture and procurement specifications.
d) Implementation: Provide Defense Logistics Agency with formulations and manufacturing techniques for obtaining gloves using the new manufacturing methods.

7. Economics: This project involves three years of effort total 0.829 MIL (0.510 1st year - 0.165 2nd year - 0.154 3rd year) (b) The injection molding method would decrease cost by 50% and the aqueous dip method would reduce cost by 25% (Introduction of competition and using a nonhazardous method). (c) This project will not have any adverse effect on the environment and does not violate safety standards. The economics analysis highly favors the alternatives.

DUPLICATE

Exhibit P-16 (Part 1)
Production Engineering Measures (PEM) Project

Date: 1 May 1978

1. Project No. Q808065 (NARADCOM)

2. O&MA: 728012.12

3. Cost ($000): 600

4. Title: MM&T - The Use of Kevlar/Nylon Orthogonal Fabrics in the PASGT Helmet and Vest

5. Facility/Contractor:

6. Summary:

a. The Problem

The current cost of the basic raw material, Kevlar, which is used in the PASGT helmet and vest is $8.50 per pound. The raw material cost accounts for 70 percent of the total projected cost of the PASGT helmet and 75 percent of the total projected cost of the PASGT vest. This represents a significant increase over the raw material cost of the currently used helmet and vest. A reduction in the raw material cost of the PASGT items without a sacrifice in performance is possible with the application of scientific textile principles to properly engineered woven fabrics.

b. The Solution

A series of fabrics will be designed, manufactured and evaluated. This series will include, but not be limited to: Kevlar/nylon orthogonal fabrics, Kevlar spun yarn fabrics, alternately constructed Kevlar woven fabrics and Kevlar fabrics of unique structures (weftamatic, Tricon, Dow-weave).

R-D

The fabrics will be evaluated for their physical, mechanical, water repellency and ballistic properties. The ballistic properties will include evaluation against fragmentation and small arms missile threats.

End items will be prepared from selected fabrics and field tested to determine user satisfaction.

c. The End Product Date: 1 May 1978

The end product of this investigation will be a technical report which will include specification requirement data for an alternate fabric for use in the PASGT helmet and vest. This fabric will be equal to or better in ballistic properties than that which is currently used in the PASGT items and will be capable of being produced at a lower unit cost.

d. The Implementation

Procurement of the new raw material for the PASGT helmet and vest will result in an estimated 20 percent cost reduction in raw materials.

7. Economics:

a. There has been no past PEM funding and there is no current PEM funding for this project.

b. This project is a three year effort requiring $250,000 in FY80, $200,000 in FY81 and $150,000 in FY82 for a total project cost of $600,000.

c. This project will result in an estimated cost reduction of $4,660,000 over a 10 year period. The break-even point is 4.4 years.

d. Performance of this project will have no adverse effect on the environment and will not violate safety standards.

8. Items Supported:

a. PASGT Helmet

b. PASGT Vest

9. Current and Projected Requirements:

a. The PASGT helmet and vest have not yet been typed classified by the Army; therefore there are no current requirements. However, type classification of both items is due in the summer of 1978.

b. The projected annual requirement of the PASGT helmet and vest is approximately 94,500 and 13,500 units respectively. This results in a projected annual requirement of approximately 720,000 square yards of Kevlar

Exhibit P-16 (Part 1)

Production Engineering Measures (PEM) Project

1. Project No.: Q808066 2. Code: 728012.12 3. Cost (M): 1,500

4. Title: MM&T - Continuous Filament Helmet Preform

5. Facility/Contractor:
It is planned to accomplish this project at Geonautics Inc., Newburyport, MA, since it is based on a proprietary method by Geonautics Inc. The US Army Natick Research and Development Command (NARADCOM) is the primary Agency responsible for supervision and control of contract effort and will provide in-house engineering support.

6. Summary:

a. The Problem: The conventional method for molding helmets is from preforms consisting of layers of resin impregnated fabric patterns. Such a method is an inefficient application of the fiber and in the case of Kevlar fabric is very wasteful and costly.

b. The Solution: The proposed continuous filament application eliminates the need and the cost of weaving, impregnating, cutting and laying up patterns. The method simply continuously lays up the Kevlar filament in a random fashion while the resin is simultaneously applied to the filament preform.

c. The End Product: Proposed project will result in development of automated production equipment, the testing of the equipment, technical drawings, specification for equipment, a demonstration of the method, and a report indicating operating procedures for making helmet preforms. All equipment bought for this project will be the property of the US Government.

d. Implementation: A computer assisted method will be established which will adapt a moveable helmet preform mold and synchronizing the application of the continuous filament to that mold through an air gun as well as applying a predetermined amount of resin uniformly to the preform.

7. Economics:
This proposed method is a proprietary method and as such has not received any Government Sponsored R&D efforts. There has been no past PEM funding and there is no current PEM funding for this project. This is a two year effort requiring $500,000 in FY80 and $500,000 for FY81. Total cost is $1,000,000. It is envisioned that the bulk of the monies will be used to procure computerized equipment that will "randomize" the filament preform in exactly the same way for each preform.

Performance of this project will have no adverse affect on the environment and will not violate safety standards The Economics Analysis highly favors this alternative.

Project No. Q808066 (NARADCOM)

DUPLICATE

EXHIBIT P-16 (PART I) DATE: 1 Jul 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM)PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R801026(MIRADCOM) 2. 2597 3. Cost: .255M

4. Title: MM&T - Low Cost Manufacturing Techniques for the High Production of Missile Vanes

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: a. Problem: Control vanes, fins and external rocket and missile fairings are generally fabricated from machined metal castings and forgings. This type of fabrication presents three basic problems; (1) high cost, (2) weight penalties, and (3) long lead time. The PERSHING and GSRS rocket are prime examples were cost and weight savings could be achieved by substituting molded, high temperature fiber reinforced composites. The PERSHING control vanes require high cost 17-4 steel castings to meet the temperature profile requirements. The GSRS rocket will require very high production rates at low cost. Temperature requirements dictate high density steel or higher cost titanium to meet the high temperature profiles. Advanced composite materials such as USP 773 and P-7703 have the potential of both cost and weight reduction for these applications. b. Solution: High production rates for missile and rocket systems require low cost, high rate manufacturing processes. Automation of composite materials offer an opportunity to meet both the high production rate and relatively low cost. Composite material systems have also been developed for both the medium (350-400F) and short high temperature (750-900F) profile requirements. Composite systems satisfying these requirements are, (1) HERCULES 3501-5A(350-400F) and (2) Rhodia, Kinel 5504, (750-900F). The HERCULES 3501-5A is a graphite-epoxy system and the Kinel 5504 is a glass-polyimide system. Both systems are eadily available, well documented and capable of satisfying the economic and structural requirements for missile fins and control vanes. Several government and industry programs have been conducted to demonstrate and apply similar composite material systems to aircraft and missile components. These programs were funded to develop manufacturing processes and design allowables for composite materials. The Grumman F-14 Horizontal Composite stabilizer and the Grumman, B-1 Composite Stabilizer are prime examples of this new composites technology. This program would provide for automation of pre-engineered broadgood on a N/C tape laying machine. The broadgoods are precut and compression molded or adhesively bonded to metallic components. c. End Products: The end product of this program will be for the automated production techniques and procedures, other products will include technical reports, prototype hardware, and an industry demonstration. d. Implementation: After completion of this project, action will be taken to disseminate results to project manager, other commands and services.

7. Economics: This program will cost .255M in FY80 and .200M in FY81. Based on past usage, a savings of $1,500,000 should results over a projected 5 year period. Performance of this project will have no adverse effect on the environment or safety standards.

Project No. R801026(MIRADCOM)

EXHIBIT P-16 (PART I)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
RCS CSGLD 1125 (RI)

RECEIVED
5 JUL 1978

Date: 1 Jul 78

1. Project No. R803142(MIRADCOM) 2. 4250 3. Cost: .200

4. Title: MM&T - Production Methods for Low Cost Paper Motor Components

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: Problem - The purpose of this project is to establish the manufacturing methodology for producing low cost paper solid propellant rocket motor components. Rocket motor costs to meet design-to-cost production goals have dictated re-evaluation of motor component materials and fabrication processes. Since tactical missile cases comprise up to 50% of the propulsion system costs, emphasis must be placed on establishing new case manufacturing processes to lower total motor costs. Recent R&D efforts have led to the concept of adapting the motor component design to utilize tubular products to the maximum extent to achieve minimum production cost. One highly promising concept for motor components is the paper/matrix tube process. This process consists of laminating binder-coated strip paper on an accurately dimensioned mandrel, curing the laminate and cutting tubes to the desired length. The problem is to optimize mill fabrication procedures to obtain the lowest cost while increasing reliability. Solution - This project would optimize the mill fabrication procedures for paper laminate tubular products to provide production engineering data essential to current and future motor component requirements. End Items - End products of this project will include: (1) Manufacturing data which will consist of data for processing specifications, material requirements, equipment requirements, processing data and quality control data. (2) Technical reports on detailed manufacturing processes, test procedures and program results. (3) Components for rocket motor firing demonstrations. Implementation - After successful completion of this project, action will be required to disseminate results to project managers, other commands and other services. Special emphasis will be placed on applicability to those items scheduled for production. The project managers will be kept abreast of the progress on this project and will be requested to implement the benefits of this program.

7. Economics: This Agency has conducted a feasibility demonstration for a 6 inch diameter solid propellant motor utilizing the paper laminate tube concept. This R&D effort was conducted under DA Project Nr. 1M362303A214 and totaled 200K. This project will cost $275K for FY79 and $200K for FY80. The economic analysis for this project is based on the structural requirements for an area fire saturation mission of 50,000 units per year. This would represent a uniform annual savings of $5,845,700 per year over a four year period. Execution of this project will not have a significant impact on the environment.

DUPLICATE

EXHIBIT PEIS (PART I)

DATE: 1 Jul 78

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSGLD 1125 (R1)

1. Project No. R803219(MIRADCOM) 2. 2597 3. Cost: .200M

4. Title: MM&T - Automatic Polymer Attachment Production Methods

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: (a) Problem: The use of hybrid microelectronic circuit assemblies for missile guidance and control systems provides the advantage of significant savings in packaging volume and weight. The assemblies represent a vital part of current and future missile systems. Present microelectronic technology employs metallurgical bonds to attach chips to substrate. While metallurgical bonds exhibit excellent performance and reliability characteristics, they are time consuming and do not lend themselves to easy repairability in cases of bad chips. Polymer bonds is an alternative to the metallurgical bonds. These bonds provide a more cost effective means for the production of microelectronics assemblies. The present technology employees a polymer dispensing machine which must be operated manually. This is a time consuming and costly process, and can be made more effective by automation. ECOM is conducting a project on "Automatic Assembly of Hybrids" that has shown that automated polymer bonding is possible. The use of automated polymer bonded hybrid chip will increase the yield by 25 to 30%. (b) Solution: This project is to develop an automatic production polymer attachment method that will dispense the exact amount of polymer onto a substrate, pick the chip from the wafer pack, and orient the chip before placing it onto the polymer. Results of ECOM 74-0637-1, NASA TMX-64789, and NASA TMX - 64908 will be coordinated in developing this new production method. (c) End Product: The end items of this project will be an industry demonstration and assemblies for verification of production method and will include: (1) manufacturing data which will consist of data for processing specifications, material requirements, equipment requirements processing data, and quality control data, (2) technical reports on detailed manufacturing processes, testing procedures, and program results, (3) assemblies for validation of process by MIRADCOM personnel. (d) Implementation: After successful completion of this project, action will be taken to disseminate results to project managers, other government agencies and commands. Special emphasis will be placed on applicability to those items scheduled for production. Project managers will be kept abreast of the progress on this project and will be requested to implement the benefits of this program.

7. Economics: This project will cost .200M for FY79 and .200M for FY80. The economic analysis for this project is based on present and future mission requirements of 10,000 typical hybrid microelectronic assemblies per year. The present cost of hybrid microelectronic assemblies is approximately $250,000 per unit. The cost with this MM&T project will be reduced to $200,000 per unit. This represents a total potential savings of $4,000,000. Execution of this project will not have a significant impact on the environment.

EXHIBIT P-16 PART II

DUPLICATE

Date: 1 Jul 78

RECEIVED
5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM)
PROJECT RCS CSGLD 1125 (R1)

1. Project No. R803280 (MIRADCOM) 2. 2597 3. Cost: .240M

4. Title: MM&T - Manufacturing Parameters for Thermal Batteries

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: (a) Problem: Thermal Batteries are used on a large variety of missiles to provide an in-flight source of electrical power. Basic theory has been established and our findings indicate the necessity of strict methods of control in the manufacturing of internal components of the thermal battery. The component of major concern is the depolarizing pellet. Due to the present limited specifications in which these pellets are manufactured, the final component lacks reliability. The present manufacturing process causes uneven density, chipping, and overall crumbling of the pellet before and after assembly. Strict manufacturing controls for these pellets must be developed in order to increase reliability and reduce the cost by gaining higher yields. (b) Solution: Inspection of present manufacturing methods, improvement of equipment, composition, assembly techniques, as well as alternate methods of production should be investigated. Thorough documentation of the process parameters will have an overall cost savings influence and provide for process adjustment through the use of computer analysis; i.e., statistical correlation of parameter tolerances and yields. (c) End Products: Project end products will include (1) technical reports on detailed manufacturing processes and test procedures to assure uniform fabrication; (2) computer program for analysis of manufacturing parameters; (3) manufacturing data for processing specifications, material requirements, and quality control requirements. (d) Implementation: After successful completion of this project, action will be taken to disseminate the results to project managers, other commands, and other services.

7. Economics: This project will cost .145M in FY79 and $.240M in FY80 It is estimated that it will save two percent of the battery cost in materials and twenty percent of the cost in manufacturing. The latter estimate will be achieved primarily through reduction in manufacturing rejections, and will result in a savings of $2,000,000 a year for an average 500,000 batteries per year procured. The execution of this project will not have a significant effect on the environment.

EXHIBIT P-16 (PART I)

DUPLICATE

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
RCS CSGLD 1125 (RI)

RECEIVED 5 JUL 1978

1. Project No. R803396(MIRADCOM) 2. 2597 3. Cost: .180M

4. Title: MM&T - Injection Molding of Low Cost - One Piece Nozzles

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected

6. Summary: Problem - Currently, solid propulsion system nozzles are being fabricated by using a number of materials and components joined together by various techniques. Therefore substantial production time and cost are involved as a result of the multi-component construction. These components are performance driven with hardware manufactured using conventional methods by aerospace vendors. This leads to production costs dictated by the aerospace learning curve and the specific production quantity involved. Recent R&D efforts have led to the concept of adapting the motor component design to utilize new material concepts to the maximum extent to achieve minimum production cost. One such effort utilizes injection molding with advanced materials technology to fabricate one piece, low cost nozzles. Solution: This project will optimize the injection molding/new material process to produce one piece nozzles. This will be accomplished by materials selection, establishing molding processing techniques, establishing tool design parameters and evaluating prototype components. End Products - End products of this project will include: (1) manufacturing data which will consist of data for processing specifications, material requirements, equipment requirements, processing data and NDT control data. (2) Technical reports on detailed manufacturing processes, test procedures and program results. (3) Components for rocket motor firing demonstrations. Implementation - After successful completion of this project, action will be then to disseminate results to project managers, other commands and other services. Special emphasis will be placed on applicability to those items schedules for production. Equipment and hardware will be available for production items.

7. Economics: Feasibility demonstrations have been conducted by private industry with various injection molding/high temperature materials processes. This R&D effort was conducted under DA Project Nr. 1M362303A214 and totaled 150K. This project will cost.180M for FY78 and.180M for FY80. The economic analysis for this project is based on the structural requirement for an area fire saturation mission of 50,000 units per year. This would represent a uniform annual savings of $1,249,800 per year over a two year period. Execution of this project will not have a significant impact on the environment.

DUPLICATE

EXHIBIT P-16 (PART I)

DATE: 1 July 1978

RECEIVED
5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM PROJECT)
(RCS CSGLD 1125 (RI)

1. Project No. R803449 (USAMIRADCOM) 2. 4250 3. Cost: .150M

4. Title: Optional Propellant Ingredients to Replace Potential Toxic, Environmental, Hazardous, and Discontinued Materials

5. Facility/Contractor: USAMIRADCOM/Contractor to be selected.

6. Summary: a. Problem: Each year a number of chemical ingredients used in solid rocket propellants become "unavailable" because the producer discontinues production. They are discontinued because the production requirements are small and increased environmental and toxicity restrictions/regulations. In some cases the ingredients are available only from foreign sources--and the foreign producer does not wish to establish facilities in this country, and U.S. chemical producers do not wish to license the process for use here because of toxicity and environmental problems. A specific case is isophronone diisocyanate (IPDI), a curing agent for hydroxyterminated polybutadiene (HTPB) polymeric binders used in a number of propellant formulations and missile systems such as VIPER. This material is produced in West Germany and one of the intermediate chemicals used in the manufacture of IPDI is phosgene. Because of the toxicity, transportation, and environmental problems associated with phosgene, no U.S. company wants to be involved with the process. b. Solution: IPDI is presently prepared by a continuous process where 1 - amino - 3 (aminomethyl) - 3, 5, 5 - trimethyl cyclohexane (IPD) in a selected solvent is treated with phosgene gas, converting the IPD to the isophorone disocyanate (IPDI). Laboratory studies show that IPDI can be made in a batch process by reaching 1 - [3 - (3,3 - diethyiureadimethyl) - 3 5, 5 - trimethyl cyclohexyl] - 3,3 - diethyl - urea in a solvent with dry CO_2 and Hcl at 165°C. It is proposed to scale up this laboratory process and demonstrate a competitive process where environmental and toxicity problems have been minimized. c. End Product: A process will be developed/demonstrated for the manufacture of an essential propellant ingredient in the U.S. without serious environmental impact problems. The process can be used by government or transferred to industry. d. Implementation: A process is available for implementation as required to maintain a reliable supply of IPDI to support propellant production.

7. Economics: This project will result in significant savings of time and cost in missile system procurements. Delays will be avoided while new compositions are developed. Propellant development programs can avoid potential problems. This project is not amendable to an economics analysis since no alternate approaches are available. The proposed project is exempt from economic analysis/cost savings evaluation by AR 11-28, Chapter 1, Para 3.d(3).

Project No. R803449 (USAMIRADCOM)

EXHIBIT P-16 (PART I)

DUPLICATE

1 JUL 1978

PRODUCTION ENGINEERING MEASURE (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. T804264 (USATARADCOM) 2. PA 3197 3. Cost 125K

4. Title: MM&T: Track Inserts and Fillers for Track Rubber Pads (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/USATECOM, Track Manufacturers

6. Summary:

a. Track vehicle pads have to be replaced frequently due to chunking, chipping and excessive wear while the life expectancy of the steel components of track has steadily increased to 4,000 or 6,000 miles, depending on the track. Processing procedures for new fibrous filled track pad compounds must be formulated.

b. This project is establishing manufacturing methods and techniques for the recently developed fillers for track pads which will require less maintenance than current production. A production process is being established for incorporating these filler materials in existing track formulations with vehicle evaluation to confirm the performance of production samples produced in existing rubber equipment. In the R&D phase, sample pads were fabricated by TARADCOM and road tested at Aberdeen Proving Ground. Results were promising at the end of this test. The product to be utilized is "Kevlar". The fibers are incorporated in the rubber compound to reduce chunking and chipping. This project will increase the life expectancy and durability of the existing track rubber compounds.

c. The end product will be complete fabricating techniques for track pads; all technical data necessary for preparation of quality assurance requirements for track pads, and Final Report defining fabrication techniques and test results.

d. The program will be implemented by changes to the Technical Data Package describing the fabricating techniques required for this type of track pad, and modification of the specification to provide quality control.

e. The execution of this project will have no significant impact on the quality of the environment.

f. Technically knowledgeable person: E. Gow, DRDTA-RCKT, AV 273-1331.

7. Economics:

a. Previous R&D efforts have been 20K in FY75. The project required 200K for FY78 and will require 125K for FY80.

b. The FY74 program which was completed in FY77, increased track pad life from an average 1,000 mile life expectancy to 1,200 to 1,300 miles. Using this new process, track life will be further increased to an average life expectancy of 1,400 to 1,500 miles. The current cost of a T142 track pad is $4.22 (newly developed compound) or .00352 to .00325/mile of operation based on the increase of average track life from the FY74 program of 20% to 30%. This figure will be further decreased to .00301 to .00281/mile of operation based on the track life increase of 40% to 50% using this new process.

c. No violation of safety standards are expected.

EXHIBIT P-16 (PART I)

PRODUCTION ENGINEERING MEASURES (PAA) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T804389 (TARADCOM) 2. PA 5197 3. Cost 150K

4. Title: MM&T: Production of Foldable Plastic Tops for Soft Top Truck Cabs (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

DUPLICATE

6. Summary:

a. Presently military trucks utilize canvas tops to cover the crew area. The tops afford operating personnel a minimum of comfort, protection, and convenience. Moreover, the tops are difficult to install when cold or wet and are subject to abuse and damage causing frequent replacement. OASHA requirements call for a reduction in the noise level, thus a sound deadening inner lining is required. The problem, herewith presented, is a need to develop an economical manufacturing method which will permit the production of a new cab top with sound-deadening material without the use of the present time consuming steps used during processing and installation.

b. This program will establish the fabricating techniques to mold a one-piece thermosetting reinforced foldable plastic cab top into a single manufacturing operation. This can be accomplished by the refinement of a production process in which two metered urethane liquid components are mixed by impingement and injected into a mold at high speed under low pressure. Production controls and quality assurance provisions will be refined and manufacturing methods simplified. The proposed cab interior would incorporate sound deadening liner material with a removable hatch for easy access to gun mount. A roll-over bar would be fabricated according to latest specification for protective structures and made a part of the removable plastic cab kit. For storage on the vehicle, the cab top would be collapsible with a hinge and locking mechanism for the roll over bar.

c. The end product of the two year program will be a technical report, drawings, specification requirements and prototypes.

d. The implementation of results of this program would be done from technical data package and ECP.

7. Economics:

a. Preceding government sponsored R&D effort has been undertaken.

b. Total funding for the two years will be 375K, FY79 225K and 150K for FY80. No additional money will be required for implementation.

c. This project will not violate any safety standards.

EXHIBIT P-16 (PART I)

RCS CSCRD-165 (R1) 1 JUL 1978

1. Project No. T805007 (TARADCOM) 2. PA 5197 3. Cost 190M

DUPLICATE

4. Title: MM&T: Advanced Technology Brake Lining Materials (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI 48090/AMMRC, Watertown, MA 02172/USATECOM, APG, MD 21005

6. Summary:

a. The objective of this project is to develop processing parameters and scale-up for the manufacture of brake lining material for large wheeled vehicles. Benefits will be a brake lining of doubled life at a total ownership cost of half that of currently used lining.

b. Arresting the momentun of a large vehicle requires brake lining materials with resistance to thermal shock and mechanical wear as well as having a good damping capacity. The combination of properties is difficult to achieve. Generally, a compromise is made with a sacrifice in wear resistance. This avoids catastrophic failure but results in frequent lining replacements. Improving wear resistance without sacrificing other material requirements offers a substantial saving in replacement costs. In tests thus far, the "gridded" concept for brake linings has been shown to be comparable to conventional brake lining materials in all respects, with the exception that wear life and fading characteristics are much improved. For example, low temperature performance, damping capacity (squeal), or effects on brake drums were found equivalent to conventional materials in tests on smaller vehicles. Laboratory developments have now shown that the gridded concept can be produced in the necessary thicknesses to scale prototype development into commercial practice for the materials required for Army use. This is a second year effort of a two year program. This effort will be directed to extensive evaluation of the manufacturing processes which will include both laboratory and vehicular tests.

c. The end-item of this program will be drawings, experimental hardware, and a technical report.

d. Implementation of this process will be accomplished by the ECP procedure.

e. The execution of this project will have no significant impact on the quality of the environment.

7. Economics:

a. This project is not the direct result of an R&D effort. The R&D effort was performed at Gould, Incorporated, and other private companies. The PAA cost for FY79 - 190M; FY80 - 190M. There will be no additional government costs to implement these PAA project results.

b. This project will result in approximately a 50% savings in replacement costs for brake shoes. The total cost savings is estimated to be approximately two million dollars over the life of the new lining in the vehicle fleet.

c. The performance of the project will not violate any safety standards.

DATE: 1 ~~June~~ JUL 78

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-163 (RI)

1. Project No: T805019 (TARADCOM) 2. PA 5197 3. Cost: $290K

4. Title: MM&T: Storage Battery, Low Maintenance—Phase III

5. Facility/Contractor:

a. Facility: US Army Tank Automotive Research and Development Command, Warren, MI 48090

b. Contractor: To be selected

6. Summary:

a. Fabrication of a plastic case maintenance free military battery requires techniques for reinforcing the battery case with complex internal stiffeners without an apparent internal or external volume or dimensional change. Reinforcement material must be such so ~~or~~ as to not ~~to~~ cause battery acid leakage which would result in battery failure and cause considerable damage through corrosive actions.

b. 2HN tactical vehicle size battery case will incorporate the battery grid techniques, previously establishing the fabrication methods to assure production of impervious integral surfaces, with high impact strengths. Utilization of plastic battery cases was demonstrated in an R&D project in FY 74. The Phase I effort of this program provided for the adoption of dry-charged maintenance free battery plates, Phase II provided a prelimmary maintenance free size 6TN military battery for heavy vehicles. This Phase III will provide a 2HN size plastic container maintenance free military battery for tactical vehicles.

c. The end product of this project will be a report describing manufacturing processes and technology for a high impact plastic container tactical vehicle type 2HN military maintenance free storage battery.

d. This PEM project will provide necessary data, technical reports of laboratory and field evaluations and preparations for TDP. No additional PEM program will be required for final implementation.

e. The execution of this project will not have a significant impact on the quality of the environment.

7. Economics:

a. An R&D effort in FY 74 for $45K resulted in the development of battery containers to determine the feasibility of using plastics to improve strength, decrease fabrication time and eliminate leakage. PEM funds of $300K were expended in FY 77 and 78 to provide the military 6TN size plastic container maintenance free battery. This PEM project funding is $290K for FY 80 for a tactical vehicle battery, size 2HN maintenance free, in a new plastic container. There will be no additional Government costs required to implement the PEM project results.

b. The results of this PEM project will extend average battery life by approximately 8%. This increase in life of the battery will reduce procurement costs by approximately 3% per year. The processes used will result in a cost savings of approximately 5% per battery because it will utilize the more readily available materials which are compatible with what is used in commercial vehicle equipment.

c. Performance of this project will not violate safety standards.

8. Item Supported:

The 2HN military batteries are used in tactical vehicles of the 1/4-ton size trucks up to 2-1/2 ton trucks.

9. Current and projected requirements:

There are no known projections for a decrease in the quantity of production support. Currently, 80,000 2HN batteries at $27.31 each are procured yearly. Presently manufacturers are unable to keep up with battery demands. With the implementation of the new plastic container battery, a decrease in battery demand would be realized due to the maintenance-free concept and the longer life of the high impact plastic container.

10. Discription of Work:

Phase I, FY 77 MM&T effort provided for the adoption of a dry-charged concept to military batteries, with the application of calcium alloy grid maintenance free plates. Phase II, FY 78 MM&T effort was funded to provide prelimmary, military plastic container, 6TN size maintenance free batteries for heavy vehicle equipment. Phase III, FY 80 MM&T effort will provide all tactical vehicles up to 2 1/2-ton trucks size with a plastic container military maintenance free battery, with military drawings, specifications and all necessary data and information for TDP.

11. End Product from Project:

The end product from this FY 80 project will be a final technical report detailing performance of the 2HN size plastic container low-maintenance battery for both physical and electrical characteristics under TARADCOM, TECOM, troop and field evaluation. The final report will include data and drawings prepared for TDP.

12. Detailed Cost Summary: See Inclosure 1.

13. Time Phasing: See Inclosure 2.

14. Related Efforts: See Inclosure 3.

15. Revision Data: N/A

EXHIBIT P-16 (PART I)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PAA) PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T805045 (TARADCOM) 2. PA 3197 3. Cost 190K

4. Title: MM&T: Spall Suppressive Armor for Combat Vehicles (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI/AMMRC, Watertown, MA/Contractor to be Selected

6. Summary:

a. Woven plastic fiber composites have been developed which when applied to the interior surfaces of a combat vehicle reduce spall effects from heat rounds, nonpenetrating impacts, and bare explosive charges. The spall suppressive armor developed in order to be useful must be economically applied to the interior surface. The manufacturing problem is addressed to the method of application and the adhesive which will hold the spall armor to the vehicle well. In addition a more economical procedure must be developed which will reduce the high cost associated with a labor intensive method of manufacture.

b. The materials of the spall armor are a combination of ceramic and plastic. In order to apply these combinations to the interior of the vehicle the type of adhesive and method of application must be worked out. Variables in such a system include type of binder, binder volume concentration, degree of wetting of the fiber and the cure cylce.

c. The result of the endeavor will be a technical procurement package describing the preparation, manufacture and fastening techniques as well as the spalling properties of the interior coating.

d. Implementation of spall suppressive armor to the interior vehicles will be in kit form for older vehicles and designed into the system for vehicles now being designed. To have this system applied it will be necessary for the user to require such a system. To new vehicles no additional funds will be required. On older vehicles if the user requests costs for kit development and the cost of the materiel and its installation will be required.

7. Economics:

a. Prior year R&D on this type of bonding has been conducted by private industry and government laboratories. The proposed PAA project will require 150K - FY79 and 190K for FY80. Costs for complete implementation are not known, because the user controls the extent to which these accomplishments will be applied.

b. This project will result in combat vehicles with higher survivability resulting in a lower casualty and/or repair of vehicles. A conservative savings to investment ratio is estimated at 3.5. The reduced outlay for repairs and/or replacement of new vehicles cannot be quantified at this time.

c. The performance of the project will not violate any safety standards. The execution of this project will have no significant impact on the quality of the environment.

EXHIBIT P-16 (PART I)

PRODU ON ENGINEERING MEASURES (PAA) OJECT
RCS CSCRD-165 (R1)

1 JUL 197?

DUPLICATE

1. Project No. T805065 (TARADCOM) 2. PA 3197 3. Cost 190K

4. Title: MM&T: Advanced Technology Surveillance Countermeasure Materials (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

6. Summary:

a. Combat vehicles as currently configured are detectable by infrared sensitive devices and radar guided missiles. Complex composite, materials have been developed which reduce the sensitivity to both infrared and radar. Application of this system requires the development of a manufacturing process which will provide reproducible items from batch to batch and also a method of attachment to vehicles.

b. Efforts during Phase II will be to determine whether the system developed in Phase I will perform as designed and be durable over the whole range of the military environment.

c. The results of this endeavor will be a technical package describing the preparation, application and required physical properties of this countermeasure material.

d. To implement this type of protection to the various combat vehicles will require taking the data generated and design a complete system for each vehicle. Introduction of any system will require ECP action and approval prior to procurement of the items comprising the system.

7. Economics:

a. This project is the direct result of an in-house R&D effort Project No. DA1T161101A91A FY77 - 50K. The PAA cost for FY79 - 190K and FY80 - 190K.

b. This program will provide a means of reducing vulnerability of combat vehicles to detection by infrared emission and radar reflectance radiations.

c. The performance of this project will not violate any safety standards, nor adversely affect the environment.

EXHIBIT P-16 (PART I)

PROI TION ENGINEERING MEASURES (PAA PROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T805067 (TARADCOM) 2. PA 5197 3. Cost 60K

4. Title: MM&T: Plastic Battery Box (Phase II)

DUPLICATE

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

6. Summary:

a. Current battery boxes are made from deep drawing low carbon steel and corrode rather rapidly when battery acid is spilled. Sometimes protective coatings are applied, but these are not totally effective. Thus, the battery boxes are replaced frequently. To reduce this replacement a technique for making these from a noncorrosive plastic is required.

b. The solution is to optimize a production technique of rotomolding a cross-linked polyethylene capable of meeting the military vehicle requirements. Cross-linked polyethylene has exhibited the high physical properties required and it is not attacked by sulfuric acid. R&D has been performed by industry. A test vehicle will be selected, a battery box design will be finalized and production techniques will be evaluated to optimize quality and cost effectiveness.

c. The end product of this program will be prototype hardware and a technical report detailing the production technique developed.

d. Implementation of this project will be through the ECP process. No additional funding will be required.

7. Economics:

a. This project is not the result of government R&D. The PAA cost for this project is Phase I FY79 - 60K and Phase II FY80 - 50K. There will be no additional costs to implement this PAA project.

b. An economic analysis was performed. Based on preliminary costs, the end item will be cost effective.

EXHIBIT P-16 (PART I)

PROD TION ENGINEERING MEASURES (PAA ROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T805068 (TARADCOM)   2. PA 5197   3. Cost 200K

DUPLICATE

4. Title: MMT&: New Anti-Corrosive Materials and Techniques (Phase I

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

6. Summary:

a. Tactical vehicles currently built for the Army's wheeled vehicle fleet do not utilize the latest anti-corrosion materials because the current manufacturing technology has not been updated to utilize pre-coated sheet steel. Pre-coated steel provides a much greater degree of protection against corrosion then the current standard military protective finishes; however, production techniques and equipment are not readily available to manufacture military design equipment.

b. Current tooling for stamping, welding, and processing will be modified to manufacture vehicle components from the pre-coated steel to insure the increased corrosion protection is maintained throughout the manufacturing cycle. Trial production runs will be performed on sheet metal vehicle components to determine and establish manufacturing specifications for pre-coated steel. The use of pre-coated steel in coils presents an economical solution for the elimination of corrosion in boxed-in or enclosed components such as doors, hoods, rocker panels and other structural components (rails and cross members) where dirt and moisture can accumulate to initiate corrosive action.

c. Specification requirements will be established; prototype hardware already mentioned will be manufactured. A technical report detailing the manufacturing procedures and parameters will also be generated.

d. To implement the use of these materials and procedures, drawings will have to be changed and introduced into the applicable configuration by ECP procedures.

e. The execution of the project will have no significant impact on the quality of the environment.

7. Economics:

a. This project is the direct result of R&D efforts performed by private industry. PAA funding: FY80 - 200K, FY81 - 200K. Implementation costs for drawing changes which will be applicable to PIP vehicles and new tactical vehicles will be borne by the vehicle contracts. No separate funding should be required.

b. Implementation of these innovative methods of corrosion inhibition will substantially increase the life expectancy of tank-automotive critical components, reduce replacement cost, and diminish critical down time.

c. The performance of the project will not violate any safety standards. EEOC is not applicable to this project.

EXHIBIT P-16 (PART I)

DUPLICATE

1 JUL 1978

PRODUCTION ~~ENGINEERING~~ MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No. T805075 (TARADCOM)   2. PA 3197   3. Cost 200K

4. Title: MM&T: Military Elastomers for Track Vehicles (Phase I)

5. Facility/Contractor: USATARADCOM/Contractor to be selected

6. Summary:

a. The life expectancy of the steel components of track has steadily increased to 6,000 miles depending on the track. Concurrently, the rubber components, primarily track pads, have had no increase in the average life expectancy of approximately 1,500 miles, thus, requiring four times the handling in logistics, storage and maintenance cost for each individual track.

b. This project is to establish manufacturing methods and techniques for the recently developed more durable polymer blends which will increase track pad life and reduce maintenance 30 to 40%. If these blends are also injected molded rather than compression molded, durability will be increased another 10% to 20%. Rubber compounds utilizing these polymer blends which may process without difficulty in the laboratory or developmental sized batches often require compound and/or process adjustment(s) before they become acceptable for production. The first year effort will be the adaptation of the selected compounds for production by actual factory fabrication of production batches and first round field evaluation. This is to determine if any compound and/or processing adjustment which may be necessary for production adaptation will not adversely affect the in-service durability of the end product. The second year effort will be conducting vehicle tests on second round samples to confirm the performance of production samples.

c. The end products will be complete recipes of the elastomeric compound for track pads; all technical data necessary for preparation of quality assurance requirements and a final report defining compounds and test results.

d. The program will be implemented by changes to the specification for track rubber, MIL-T-11891.

e. The execution of this project will have no significant impact on the quality of the environment.

f. Technically knowledgeable person: E. Gow, DRDTA-RCKT, AV 273-1331.

7. Economics:

a. The Government has funded R&D during FY77, $50,000 and FY78, $30,000. The proposed project will require $200,000 for FY80 and $200,000 for FY81. Additional funds will not be required.

b. Using a conservative estimate of a 20% increase in reliability, economic analysis indicates that approximately one million dollars per year would be saved. A savings/investment ratio of 11.8 has been calculated.

c. No violation of safety standards are expected.

EXHIBIT P-16 (PART I)

PROL TION ENGINEERING MEASURES (PAA 'ROJECT
RCS CSCRD-165 (R1)

1 JUL 1978

1. Project No. T806000 (TARADCOM) 2. PA 5197 3. Cost 350K

DUPLICATE

4. Title: MM&T: Light Weight Tilt-Up Hood Fender Assembly (Phase II)

5. Facility/Contractor: USATARADCOM, Warren, MI/Contractor to be Selected

6. Summary:

a. The use of reinforced plastic materials, such as sheet molding compound, for large components of tactical trucks will reduce acquisition costs, improve maintainability, decrease corrosion and decrease fuel consumption by reducing weight. Fabricating a large component such as a tilt-up hood requires manufacturing process development to provide the characteristics necessary to meet the military vehicle requirements.

b. Advances in plastic technology make possible the forming of large parts from reinforced plastic sheet in presses similar in principle to sheet metal. Because the plastic material is not monolithic, but contains a plurality of constituents, new fabricating techniques will be required to control flow characteristics of the material in the die set to produce components with varying thicknesses in its configuration. Industrial R&D has been accomplished on some truck components. Various factors must be determined to control the reinforcing agent, thickness tolerance, incorporation of pigments and strength of fittings and attachments required by military specifications. Phase I will establish the feasibility of upscaling into a production process. Phase II will cover the fabrication of full scale components and Phase III will consist of demonstration tests and field tests.

c. The end products of this program will be a developed method for fabricating large thin compounds from plastics, a specification, a final technical report and prototype hardware.

d. Implementation of this manufacturing method will be through changes to tech-data packages by ECP procedure.

7. Economics:

a. The R&D effort has been in the private section and there has been no government funded R&D. Funding is 200K in FY79, 350K in FY80 and 200K in FY81. Implementation will be performed within the scope of the project.

b. This project will enable the government to use a light weight one-piece plastic front end truck assembly which can be lifted by a single person and weighs 50% less than the conventional metal assembly. This will provide reduced maintenance labor costs and fuel savings and an easily repairable item.

c. This project does not violate any safety standards.

EXHIBIT P-16 (Part I) Date: 1 July 79

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

DUPLICATE

RECEIVED 5 JUL 1978

1. Project No.: 1807113 2. PA: 1497 3. Cost: $1,350K

4. Title: MM&T Composite Rear Fuselage Manufacturing Technology

5. Facility/Contractor: Applied Technology Laboratory, US Army Research & Technology Laboratories (AVRADCOM), Ft Eustis, Virginia and private contractor yet to be named.

6. Summary:

a. The problem: The commitment of composite materials to primary helicopter components on Army production aircraft has been limited to rotor blade components. The airframe fuselage components possess the highest potential for cost and weight savings as demonstrated in various R&D programs, however, production type manufacturing processes have not been established for large, full scale, compound curvature, primary fuselage components.

b. The solution: This project will develop manufacturing technology for fabricating large full scale, compound curvature molded composite primary fuselage structures which are lighter, possess fewer parts and subassemblies and are lower in unit cost than current metal structures. Low cost tooling, forming molds and co-curing processes for a complete fuselage component assembly will be developed within this program to insure cost competitive components with high structural repeatability and integrity.

c. The end products: This program will support the application of composite materials to a rear fuselage component for a helicopter with reduced number of parts, assembly operations and mechanical fasteners.

d. The implementation: Manufacturing processes, techniques and tooling will be directly applicable to the BLACKHAWK helicopter with interchange of information and data with other rotary with manufacturers and Government agencies by reports distribution, briefings and plant demonstrations.

e. Principal Investigator: Mr. L. Thomas Mazza, Applied Technology Laboratory, US Army Research and Technology Laboratory, ATTN: DAVDL-EU-TAS, Ft Eustis, VA 23604, AUTOVON: 927-5732/4304, Commercial: 878-5732/4304.

7. Economics:

a. This project is the second year of a three-year MM&T program, totaling $2,150,000 (FY79 - $250,000; FY80 - $1,350,000; FY81 - $550,000).

b. R&D airframe experience with graphite epoxy and Kevlar epoxy material systems and the molded frame/stringer concepts have been funded by USARTL/NASA and Sikorsky IRAD. Efforts included development of fuselage shell structures and S-76 stabilator.

c. Potential cost savings for a composite rear fuselage are expected from: (1) reduced production costs, (2) reduced life cycle costs due to improved R&M and lower weight, and (3) technology base for composite structures on future aircraft. Utilizing a 1107 BLACKHAWK helicopter procurement requirement over a 10 year period, a total discount acquisition cost savings of $3,537,552 for composite rear fuselage components procured during FY82 through FY87 is estimated.

d. The execution of this project will not have a significant impact on the quality of the environment (see Inclosure 2, Environmental Assessment Statement).

EXHIBIT P-16 (Part I)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 5 JUL 1978

JUL 1978

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1. Project No.: 1807119 (AVSCOM) 2. PA: 1497 3. Cost: $400

4. Title: MM&T Non-Destructive Evaluation Techniques for Composite Structures

5. Facility/Contractor: U.S. Army Aviation Systems Command, St. Louis, MO: U.S. Army Materials and Mechanics Research Center, Watertown, MA; and private contractor(s) to be determined.

6. Summary:

a. This project will provide a manufacturing handbook for non-destructive in-process inspection of composite structures.

b. The R&D in support of this program has been funded by the Army, Air Force, Navy, and NASA and by private industry. The Army's Materials Testing Technology (MTT) Program has established many of the production test and inspection techniques that are used to inspect composite materials.

c. A large number of non-destructive testing (NDT) techniques have been developed and are being used with composite structures with widely varying configurations. NDT methods such as ultrasonic, transmission and reflection infrared, acoustic emission, acoustic holography, optical holography, and neutron and X-radiography have been used. Various manufacturing defects such as debonds, gaps, overlaps, cracks, wrinkle and fiber breakage can be detected. The structures examined range in complexity from skins, flat panels and curved panels through rotor blades.

This project will initially use the composite rotor blade to develop data for the project. Then, once the data is obtained, the information obtained would be applied to other composite structures. Depending on the configuration and stress levels in the structure, various criteria will be established for acceptance or rejection based on number, type and size of the measured defects. The proposed Handbook will list the types of structures inspected, the type of inspection methods used, the defects tested for, and the acceptance/rejection criteria used.

Point of contact for this project is Mr. M. A. Kornitzky, AV 955-3524.

7. Economics:

a. This project is a four-year MM&T effort totaling $1,362,000 (FY77-$475k: FY78-$87K; FY79-$400k; FY80-$400K).

b. The use of this Handbook by designers and manufacturing personnel will lead to improved inspection techniques. This will result in more accurate inspection and a corresponding net savings in excess of $1,800,000.

c. The execution of this project will not have a significant effect upon the quality of the environment (See Inclosure 2, Environmental Assessment Statement).

DUPLICATE

Date: 1 Jul 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECTS
RCS CSGLD 1125 (R1)

1. Project No: 1807183   2. PA: 1497   3. Cost: $355
4. Title: MM&T - Semi-Automated Composite Manufacturing System for Helicopter Fuselage Secondary Structures
5. Facility/Contractor: Eustis Directorate, U.S. Army Air Mobility R&D Laboratory, Ft Eustis, VA, and private contractor yet to be named.
6. Summary: This project is a three year program to design, fabricate and demonstrate a semi-automated manufacturing system for the production of helicopter secondary structural parts made from advanced composite materials. The proposed system is a continuous in-line automated fabrication approach in which all manufacturing operations are conducted on a preprogrammed "moving" line concept. The system will perform all the manufacturing operations necessary to produce a complete composite structural part. The operations include four stations; station 1 - Layup of material; station 2 - performing, compaction and trimming; station 3 - final assembly and station 4 - advanced "B" staging/final curing. (See Figure 1.)

Fixed wing manufacturers, supported by Air Force composite component programs, have developed semi-automatic and automated composite laminating systems. The most notable and up-to-date being the Grumman Aerospace Corp system for the F-14A and B-1 horizontal stabilizers (Figure 2). The proposed project will utilize portions of the selected Contractor's assembly line equipment already developed (primarily stations 1 and 4), with fabrication and integration of new tooling and forming stages as necessary to accommodate selected UTTAS and AAH composite secondary structures.

The proposed system will be adaptable to complete N/C and eventually to an integrated Computer Aided Manufacturing (CAM) Production Facility for the production of primary helicopter fuselage structural parts.

7. Economics:

a. This is the third year of a three year effort totalling $700,000 (FY78 - $245,000; FY79 - $100,00, FY80 - $355,000).

b. R&D for this project has been accomplished by private industry on company funds. Feasibility of this approach has been demonstrated on Air Force/NASA aircraft and space programs for automation of such items as A-7 composite wing skins, F-14 and B-1 horizontal stabilizers (Air Force Contracts with Vought Corp and Grumman Corp).

This project supports the Army cost reduction programs by reducing the production cost of future helicopter system, UTTAS and AAH.

The proposed system will provide a unique manufacturing capability that will result in a 4 to 1 manhour savings in the fabrication of helicopter composite secondary components. It will also increase overall product quality. (See Inclosure 1 - Economic Analysis.)

c. The execution of this project will not have a significant impact on the quality of the environment (See Inclosure 2, Environment Assessment Statement).

EXHIBIT P-16 (Part I)

Date: JUL 1 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

PCS CSCRD - 165 (R1)

1. Project No.: 1807198 (AVRADCOM)   2. PA: 1497   3. Cost: $440

4. Title: MM&T - Composite Material Engine Accessory Gearbox Housing

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Ft Eustis, VA, and a Contractor to be determined.

6. Summary:

a. The problem. It is necessary to reduce the weight and cost of the T700 engine accessory gearbox housing. The T700 engine, which is currently used in the UH-60A and the AAH, incorporates an accessory gearbox case which is fabricated from an aluminum alloy (other turboshaft engines use aluminum or magnesium) and thus is not optimized for lowest weight and cost, and in the case of magnesium it is vulnerable to the environment.

b. The solution. This project will establish manufacturing technology for a composite material accessory gearbox case for the T700 engine. R&D in support of this project has and is being performed by private industry using Navy and Army funds.

c. The end products. This project will develop optimized manufacturing technology for the fabrication of a composite material accessory gearbox case for the T700 engine.

d. The implementation. Technology gained from this project will be disseminated to industry and other Government agencies by distribution of reports and presentation of briefings.

e. Principal Investigator for this project is: James Gomez, Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), ATTN: DAVDL-EU-TAP, Ft Eustis, VA 23604, AUTOVON: 927-4301, Commercial: (804) 878-4301.

7. Economics:

a. This is the second year of a two-year MM&T program totaling $640,000 (FY79 - $200,000; FY80 $440,000)

b. R&D efforts preceding this project were accomplished by private industry contractors for the Army and Navy and totaled approximately $614,000.

c. The composite material case design and optimized fabrication methodology will enable the engine accessory gearbox case to be significantly improved, due to the inherent advantages of composite materials, i.e., less weight and improved structural load-carrying characteristics. Cost savings will result due to the ease of manufacturing of the composite material engine gearbox casing. The current cost of approximately $14,000 for the complete accessory gearbox is considered high. Based on a projected buy of 3,576 engines through CY87, it is anticipated that a savings of $727,700 will result in the gearbox case itself. An additional $700,000 is expected to be realized by signficant improvements in repairability, serviceability, and replacement costs over the current aluminum housings.

d. The execution of this project will not have a significant effect on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement).

Project No. 1807198

EXHIBIT P-16 (Part I) DATE: MAY 1 1978

DUPLICATE

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT Project No. 1807200

RCS CSCRD - 165 (RI)

1. Project No.: 1807200 (AVRADCOM) 2. PA: 1497 3. Cost: $550K

4. Title: MM&T - Composite Engine Inlet Particle Separator

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Ft Eustis, VA and a private contractor to be selected.

6. Summary:

a. The Problem. The current fabrication process for the T700 inlet particle separator (IPS) involves machining of castings and forgings and the subsequent joining of these machined parts by welding and brazing. This process is costly in terms of both material utilization and manufacturing labor. The scroll of the IPS is currently hand laid-up fiberglass, composite but expensive.

b. The Solution. Fabricate the IPS from injection molded thermoplastic composite, combined with high modulus/high strength thermosetting composite (graphite-polyamide).

c. The End Products. Establishment of a new production fabrication process for the T700 IPS, prototype models, complete technical data package and quality control package.

d. The Implementation. Technology gained from this program will be disseminated to industry and other Government agencies by distribution of reports and presentation of briefings. Technology gained will also be available for use on the T700 engines for UTTAS and AAH.

e. Principal Investigator. David B. Cale, Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), ATTN: DAVDL-EU-TAP, Ft Eustis, VA 23604, AUTOVON: 927-2969, Commercial: (804) 878-2969.

7. Economics:

a. This is the second year of a two-year MM&T program totaling $750,000 (FY79 - $200,000; FY80 - $550,000).

b. R&D efforts preceding this program were performed by private industry and funded from a number of sources, including IR&D. Total R&D funding data is not available.

c. The results of this program will provide for reduction in the cost of the T700 inlet particle separator. Anticipated discounted net savings are $4,110,400 (See Incl 1, Economic Analysis). In addition, there is an associated weight savings of 10 pounds per engine.

d. The execution of this project will not have a significant effect on the quality of the environment (See Incl 2, Environmental Assessment Statement).

EXHIBIT P-16 (Part I)

Date: 1 July 78

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

RCS CSCRD 165 (R1)

RECEIVED 7 AUG 1978

1. Project No.: 1807202 2. PA: 1497 3. Cost: $275K

4. Title: MM&T - Application of Thermoplastics to Helicopter Secondary Structures

5. Facility/Contractor: Eustis Directorate, US Army Air Mobility R&D Laboratory, Ft Eustis, VA; Army Materials and Mechanics Research Center, Watertown, MA, and contractor yet to be named.

6. Summary:

a. This proposed task will develop thermoplastic manufacturing technology to fabricate full-scale flight-worthy secondary structures with a reduced cost as compared to epoxy composite and metallic counterpart components. Initial effort for this program will consist of detail structural/material configuration formulation of selected aircraft component (fairing, access panel, cover, etc.), tooling development, and fabrication of full-scale components. Both laboratory and field tests will be conducted in order to perform comparison analysis (cost, structural integrity, weight, repair/maintenance characteristics) with metallic and/or thermoset (epoxy) counterpart.

b. The R&D relating to this project has been performed under Air Force and industry-funded R&D projects conducted by General Dynamics - Convair Division, Boeing Vertol, and Bell Helicopter. The R&D effort has consisted primarily of establishing process variables, material properties, and coupon/component subsection fabrication and laboratory tests.

c. The advantages of thermoplastics over thermosetting (epoxy resin) composite and metallic systems for secondary structures is reduced cost and improved repair/maintenance characteristics. In such helicopters as the CH-47, UTTAS, and AAH, a number of secondary structures, i.e., fairing, access panels, covers, etc., are fiberglass/epoxy, Kevlar/epoxy, or sheet metal materials. Selection of a suitable demonstration component could provide needed manufacturing technology development in full-scale thermoplastic application and provide a cost saving for an immediate production item.

7. Economics:

a. This project is the second year of a two-year MM&T program totaling $500,000. (FY79 - $225,000; FY80 - $275,000).

b. R&D task: Air Force and industry-funded R&D projects by General Dynamics - Convair Division, Boeing Vertol, and Bell Helicopter, FY73 - FY77.

c. This proposed project will demonstrate the required fabrication technology for the application of fiber reinforced "thermoplastic" material and full-scale airframe structural components. The "Access Cowling Assembly" for the aft pylon of the CH-47 helicopter has been selected as a typical secondary structure which could readily demonstrate reduced acquisition cost and improved operational life. Based on a current active fleet of 361 CH-47 helicopters, expected fleet size of 525 by 1995, and modernization schedule currently estimated by the CH-47 PM Office, a total discount acquisition savings of $480,810 is estimated for this component alone. The technology would be applicable to a whole family of CH-47 secondary structures. (See Inclosure 1, Economic Analysis.)

d. The execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement.)

EXHIBIT P-16 (Part I) PRODUCTION ENGINEERING MEASURES (PEM) PROJECT DATE: 1 JUL 1978
RCS CSCRD - 165 (RI)

DUPLICATE

RECEIVED 5 JUL 1978

1. Project No.: 1807243 (AVRADCOM) 2. PA: 1497 3. Cost: 125

4. Title: MM&T: Machining Operations on Kevlar Laminated Constructions

5. Facility/Contractor: Army Materials & Mechanics Research Center, Watertown, MA; Hughes Helicopters, Culver, City, CA; Sikorsky Aircraft, Stratford, CT.

6. Summary:

a. This project will develop tooling and methods to achieve basic machining operations (including sawing, cutting/shearing, turning, milling, grinding, etc.) on Kevlar laminates. Present methods tend to cause delamination and excessive fuzzing/fraying of the Kevlar cut edges necessitating the use of time consuming and repetitive techniques to achieve acceptable machined surfaces.

b. Government and private industry laboratory experience indicate that recently developed advanced cutter techniques (including high pressure water jet, lasers, as well as employing conventional diamond grinding wheel/drills) have shown progress toward effective Kevlar machining and prolonging tool life.

Kevlar is a new high stength industrial fiber (an aromatic polyamide developed by Dupont) which has demonstrated a remarkable capability for defeating fragments from both conventional and missile munitions. Kevlar is now being field tested for personnel armor including vest inserts and helmets. Currently Kevlar laminates constitute the leading candidate fragmentation armor for aircraft applications. Also because of its high strength/weight ratio it is strongly being considered for aircraft structural and reinforcing members.

7. Economics:

a. This project is the 2nd year of a two year MM&T program totalling $275,000 (FY79, $150,000; FY80, $125,000)
b. Project will provide appropriate tooling, procedures, and technology to improve the machining operations including automation techniques on Kevlar systems which will permit competitive manufacture/procurement of armor and structural components. (Armor costs range from $1000 to $1,500 per armor component).
c. A conservative estimate of cost savings should be substantial, in the order of 30%, since even incremental improvements for each of the manufacturing operations would result in an impressive cumulative savings.
d. Execution of this project will not have a significant impact on the environment (See Inclosure 2, Environmental Assessment Statement).

Project No.: 1807243

EXHIBIT P-1c (Part I) Date: 1 JUL 1978 B

DUPLICATE

PRODUCTION ENGINEERING ME[...]RES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 5 JUL 1978

1. Project No: 1[...]8 (AVRADCOM) 2. PA: 1497 3. Cost: $325K

4. Title: MM&T Determination of Optimal Curing Conditions for Processing Fiber-reinforced Composites

5. Facility/Contractor: U. S. Army Aviation Systems Command, St. Louis, MO; U. S. Army Materials and Mechanics Research Center, Watertown, MA; and private contractor(s) to be determined.

6. Summary:

a. Problem: Current methods of curing composites are based primarily on an empirical determination of required processing conditions. An initial estimate of reasonable curing conditions can normally be made using the raw material manufacturer's suggested curing cycles for small laminates; the latter are also often based on empirical studies. A trial-and-error procedure follows where laminates are processed under a given set of conditions, mechanical property tests are conducted, curing conditions are then modified, additional property tests are run, etc. This procedure is followed until the aircraft manufacturer is reasonably satisfied with laminate mechanical properties. Such procedures do not always result in optimal curing conditions, since physical tests are used to monitor the process of the chemical reaction. What is needed is an comprehensive program addressing all facets of the curing cycle with a view towards obtaining consistent and repeatible mechanical and chemical properties, reducing cure time, decreasing overall energy input, and improving productivity.

b. Solution: Factors which control the length of time involved in the four phases of the molding process - the preheat, the cure, the cooldown, and the postcure - are now definable in terms useful to the mold designer and the process developer. By developing and employing improved methods of determining required processing conditions for composites, one can thereby reduce the time and improve productivity per mold per unit time. R&D Project No. 1T162105AH84 demonstrated that one could optimize the molding process based on a knowledge of the material's behavior in each of the four molding phases.

c. End Products: The end products of this project will include a compilation of data relevant to mold design and fabrication which will increase return on investment through increased productivity per mold, and a simulated mold to demonstrate the advantages of a mold with thermal characteristics which can be varied during the production process.

d. Implementation: The results of this project will be disseminated to the helicopter industry and other Government agencies by means of technical reports and briefings.

For additional information, contact Mr. Mike Kornitzky, AMMRC, Autovon: 955-3524.

7. Economics:

a. This project is the 2nd year of a three-year effort totaling $575,000(FY 79-$125K; FY 80-$325K; FY 81-$125K.

b. R&D effort was conducted by AMMRC during the period FY72 - FY77 of an estimated cost of $400,000 under R&D Project No. 1T162105AH84.

c. The use of optimized processing procedures and associated methods to be developed under this project will increase productivity and simultaneously reduce rejection rate.

d. The execution of this project will not have a significant effect upon the quality of the environment (See Inclosure 2, Environmental Assessment Statement).

EXHIBIT P-16 (Part 1) DUPLICATE DATE: 1 JUL 1978

Production Engineering Measures (PEM) Project RCS CSCRD-165 (R1)

1 Project No. 1807294 (AVRADCOM) 2. PA: 1497 3. Cost: $150K

4. Title: MM&T Composite Apex Fitting for Army Aircraft Sling Applications

5. Facility/Contractors: U. S. Army Aviation Research and Development Command, St. Louis, U. S. Army Materials and mechanics Research Center, Watertown, MA; and contractor to be selected.

6. Summary:

a. Problem: Current Apex fitting are forged metal (steel or aluminum) items which require considerable time and labor for finishing and assembly which add to attendant costs and item weight.

b. Solution: Composite (fiber/epoxy) prototype apex fittings have been developed (hand layup) which offer an equivalent load carrying capability to the metal fittings with a weight savings of 75%. Automated production of the composite part should reduce per part costs to less than that of the metal items. Attendant benefits include non-conductivity, this reduces the threat of static discharge to ground personnel.

c. End Products: This project will develop an automated manufacturing technique (filament winding/ compression molding) for the production of composite Apex fittings, and production tooling for same.

d. Implementation: Technology gained from this project will be disseminated to industry/ and other Government agencies by distribution of reports and presentation of briefings. Implementation will occur at no additional cost to the Government. Point of contact for this project is Mr. M. Kornitzky, AMMRC, AV: 955-3524.

7. Economics:

a. This project is a 1-year MM&T program totaling $150,000; FY80 - $150,000.

b. R&D effort under Task #1T162105AH84 performed by AMMRC during FY78 demonstrated the feasibility of fabricating composite apex fittings.

c. Economics will be improved through elimination of the forging/finishing operation; performance will be enhanced by significant weight reduction.

d. The execution of this project will not have a significant effect on the quality of the environment.

DUPLICATE

EXHIBIT P-16 (Part I)

RECEIVED 5 JUL 1978

DATE: 1 JUL 1978

Production Engineering Measures (PEM) Project RCS CSCRD-165 (RI)

1. Project No. 1807299   2. PA: 1497   3. Cost: $500

4. Title: MM&T Production of Low Cost Thermoplastic Prepreg

5. Facility/Contractor: U. S. Army Aviation Research and Development Command, St. Louis, MO; U. S. Army Materials and Mechanics Research Center, Watertown, MA; and contractor to be selected.

6. Summary:

a. Problem: Currently produced thermoplastic prepregs are costly due to expensive processing equipment and are of poor quality because the resin is applied by solvent solution coating techniques. As a result, helicopter manufacturers have been reluctant to use these materials.

b. Solution: Fiber reinforced thermoplastic prepregs will be produced by hot melt impregnation by combining and modifying conventional thermoplastic calendering and extrusion equipment. This project will provide helicopter manufacturers and the composites industry with a lower cost and improved quality source of thermoplastic prepreg.

c. End Products: End Products of this project include a complete facility for production of hot melt impregnated thermoplastic prepreg for contractor evaluation and use.

d. Implementation: The results of this project will be disseminated to material suppliers, helicopter industry, and other government agencies by means of technical reports and briefings.

7. Economics:

a. This a two year effort totalling $700,000 (FY80 - $500,000; FY81 - $200,000).

b. R&D was performed by Union Carbide using private funds.

c. The proposed manufacturing process for producing fiber reinforced thermoplastic prepreg has a vast potential for cost savings on the basis of 1) reduced cost of prepreg over currently available material, 2) thermoplastic prepregs can be formed at lower cost than thermoset prepregs due to substantially lower "cure" times, and 3) lighter weight over thermoset materials. Additional benefits of the project include the capability of producing prepreg with any thermoplastic matrix (including high temperature processing polymers) and increased availability of material to Army contractors for evaluation and use.

d. The exeuction of this project will not have a significant effect on the quality of the environment.

Date: MAY 1 1978
Project No.: 1807301

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PERM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: 1807301 2. PA: 1497 3. Cost: $95

4. Title: MM&T: Filament Winding Process Fabrication of Non-Straight Tubular Elements.

5. Facility/Contractor: Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia, and private contractor yet to be named.

6. Summary:

a. The problem: There are a number of potential candidates for wet filament wound components for airframe structures that are bent to some degrees--a configuration that cannot be handled readily with current winding machines. Examples are: partial ring frame, tail surface spar, landing gear cross tube. Currently the opportunity to use non-linear tubular components, without the risk of encountering the wrinkled filaments and distorted winding patterns that compromise structural characteristics, has not been satisfactorily demonstrated.

b. The solution: A wet filament winding machine configured to wind on nonstraight mandrels would have the capability for programming for adjustable winding angles and wall thickness, using any of the commonly available filament materials, either individually or in selected mixes to achieve optimum strength/stiffness characteristics. The machine study proposed here for preliminary evaluation will be a digitally-controlled device for routinely fabricating these composite components.

c. The end products: The proposed machine study/analysis will establish its concept, operating limitations, and development cost. Methods for supply filaments, resin impregnation, and delivery to the mandrel, as well as machine control equipment, will be defined.

d. The implementation: Technology developed from this project will determine the advisability of pursuing the development of operational equipment. Documentation developed will be disseminated to industry and other Government agencies by distribution of reports and presentation of briefings.

e. Principal Investigator: Mr. L. Thomas Mazza, Applied Technology Laboratory, US Army Research and Technology Laboratory, ATTN: DAVDL-EU-TAS, Ft. Eustis, VA 23604, AUTOVON: 927-5732/4304, Commercial: 878-5732/4304.

7. Economics:

a. This project is a one year MM&T program totaling $95,000.

b. R&D Task P/N 1F263211DB41 was performed in FY74-FY77 (filament wound blades and airframe components for AH-1G) costing $2,400,000. In addition, the development cost of the filament wound AH-1Q blade was $5,400,000. A potential 10% to 30% acquisition cost savings can be realized through the application of filament wound composite structures. (See Inclosure 1 - Economic Analysis.)

c. The execution of this project will not have a significant impact on the quality of the environment (see Inclosure 2, Environmental Assessment Statement).

 DATE: 1 JUL 1978 A

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 5 JUL 1978

1. Project No.: 1807302 (AVRADCOM) 2. PA: 1497 3. Cost: $260

4. Title: MM&T - Production of Boride Coated Long Life Tools

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertown, MA, United Technologies Research Center, and other independent Contractors.

6. Summary:

a. Problem: Airframe components of fiberglass and other composites such as graphite-expoxy are difficult to machine. Conventional cutting tools wear rapidly with 5-10% of the life expected when compared to use on titanium workpieces. The quality and dimensional accuracy of holes formed with conventional tools are continuing manufacturing problems. Titanium diboride (TiB_2) coated tools, which can increase the life of conventional steel tools by up to a factor of 2 in milling operations and up to 8 in fiberglass drilling operations, are not available at an economical cost.

b. Proposed Solution: The ability to manufacture TiB_2 coated tools will be scaled up from current laboratory-sized electrolytic cells (15 lbs.) to an economically feasible production size (~300 lbs.) facility capable of electroplating various tool types and shapes. Efficacy of the process will be demonstrated through evaluation of the machining efficiency of the coated tools in field trials by various fabricators of fiberglass parts.

c. End Products: The end products of this project will include a product technical report describing special equipment requirements, processing specifications, coated tool performance and quality control methods. Also, a demonstration pilot production line capable of coating at least 100 1/4" diameter drills at one time will be constructed.

d. Implementation: Action will be to disseminate the results to various project managers and industry. Also, the technology will be transferred to cutting tool manufacturers.

7. Economics: a. An 18-month MM&T program will be conducted to scale up the process and establish a demonstration pilot facility. FY80: $200K; FY 81: $60K.

b. R&D effort under Task No. 1T162105A331 performed by AMMRC and United Technologies (FY71-$50K) established feasibility. PEM 6747524 (WECOM) demonstrated the process of coating tools with TiB_2.

c. This new manufacturing technology will make readily available a new long life tool. Total tools cost for machining fiberglass and like materials are estimated to be about 20% of the cost of conventional tools when the extra long life of the coated tool is considered. It is further estimated that tooling costs for appropriate applications is about 10 million dollars thereby indicating savings of up to 8 million dollars. (See inclosure 1, Economic Analysis).

d. The execution of this project will not have a significant effect on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement).

EXHIBIT P-16 (Part I)

DUPLICATE

DATE: MAY 1978

RECEIVED 1 MAY 1978

PRODUCTION-ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD - 165 (R1)

1. Project No.: 1807315 (AVRADCOM) 2. PA: 1497 3. COST: $150

4. Title: MM&T - Stabalized Line of Sight Gimbal Production

5. Facility/Contractor: US Army Aviation R&D Command, US Army Avionics R&D Activity, Fort Monmouth, NJ and contractor to be selected.

6. Summary:

a. The problem: Mechanical rigidity and stability are prime requirements for gimbaled platforms in a stabalized line of sight system which interfaces two or more dependant optical subsystems. Particularly in Remotely Piloted Vehicles (RPV) the weight of the platform is of equal importance. The use of graphite-epoxy (Kelvar-epoxy) composite structures will satisfy these requirements. The fundamental manufacturing problems revolve about fabricating structures with the close tolorances in dimensions and in weight balance to conform to the appropriate G-loads for scanned systems.

b. The solution: Techniques already developed for the fabrication of graphite-epoxy composite structures will be implemented and tested relative to the above stated requirements. Breakaway tooling will be used with appropriate thermal characteristics to provide the necessary tolorances. Hand forming techniques will be replaced by suitable machine wrapping methods to arrive at a lower cost product requiring less man hours and with a high yield.

c. End Products: Gimbals made of composite materials will be tested against conventional Magnesium systems to evaluate the utility and effectiveness of these lower cost processes.

d. The Implementation: The knowledge and experience gained in these efforts will be incorporated in the related projects of mini RPV, AAH, ASH, Modular FLIR, and other projects such as WOWS.

7. Economics:

a. This project is the second year of a two year effort totaling $417 (FY79 $267; FY80 $150).

b. No Government sponsored R&D on this effort has been performed. Implementation costs will be included in the contract.

c. In preparation

d. **The execution of this project will not have an adverse effect upon the quality of the environment and has a zero cost for pollution abatement.**

Project No. 1807315

Exhibit P-16 (Part I) Date: 1 July 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT Project No: 1807338

RCS CSCRD-165 (R1)

DUPLICATE

RECEIVED 5 JUL 1978

1. Project No.: 1807338 2. P: 1497 3. Cost: $875

4. Title: MM&T -.Composite Tail Section

5. Facility/Contractor: Applied Technology Laboratory, USARTL (AVRADCOM), Ft Eustis, VA, and private contractor yet to be named.

6. Summary:

a. The problem: Developmental programs have not fully demonstrated the potential cost and weight advantages of composites for airframe components due to limitations in existing fabrication techniques and processes as related to configuration restraints. Efficient and effective methods of fabricating composite airframe structures with these configuration restraints, specifically in place winding and co-curing of mechanical attachments and joints, manufacturing splices and complex contours, are the main problem areas which must be solved before composites can readily compete with production metal components for primary airframe components.

b. The solution: This project will develop filament winding manufacturing technology for fabricating airframe tail section components. Manufacturing techniques and processes, which were not developed during the R&D demo program and which will be established during the proposed program include: (1) foam filled and contoured pressure mandrels to enhance inplace winding of joints and attachments to eliminate secondary bonding operations, (2) winding to net contour shape versus current uniform cylindrical shape which are reformed during final curing operation, (3) optimize tolerance control of structural surface dimensions which require manufacturing splices (bonded and/or riveted) with mating composite or metal airframe components, and (4) improved matrix control procedures to ensure weight limits of final components.

c. The end products: This program will support the application of composite materials to airframe components (Primarily tailboom, vertical fin, and horizontal stabilizer) with reduced weight, cost, and improved field repairability

d. The implementation: Manufacturing processes, techniques, and tooling will be directly applicable to the YAH-64 helicopter with additional interchange and application to other rotary wing manufacturers and Government agencies.

e. Point of contact: Mr. L. Thomas Mazza, Appl Tech Lab, USARTL (AVRADCOM), ATTN: DAVDL-EU-TAS, Ft Eustis, VA 23604, AUTOVON 927-5732/4304, Commercial 878-5732/4304.

7. Economics:

a. This project is the second year of a 3-year MM&T program, totalling $2,150,000 (FY79 - $925,000; FY80 - $875,000; and FY81 - $350,000)

b. R&D Task Proj No. 1F263211DB41 was performed in FY72-78 costing over $1,000,000. This proposed project will provide advanced production filament winding technology to effect a reduction in cost, weight, and improved operational life, for a complete family of helicopter tail sections.

c. A total discount acquisition cost savings of $2,907,015 for composite tail sections procured during FY81 through FY86 is estimated. (See Inclosure 1, Economic Analysis.)

d. The execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement.)

Project No. 1807338

EXHIBIT P-16 (Part 1)

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

RCS CSC -165 (R1)

Date: 1 July 1978
Project No: 1807339

1. Project No.: 1807339 2. PA: 1497 3. Cost: $1,335

4. Title: MM&T - Filament Wound Composite Flexbeam Tail Rotor

5. Facility/Contractor: Applied Technology Laboratory, USARTL (AVRADCOM), Ft Eustis, VA, and private contractor yet to be named.

6. Summary:

a. The problem: Wet filament winding cocure process has been demonstrated as a viable approach to reducing manhour requirements in the construction of composite components while at the same time utilizing raw materials (i.e., fibers/matrix materials at their lowest cost) and providing repeatable/reliable structures. However, developmental programs have not fully demonstrated the potential cost advantages of composites for flexbeam tail rotors due to limitations in existing fabrication techniques and processes. Specifically, filament winding from a solid flexbeam to an open spar section, winding to net shape, improved resin control, and improved tolerance control are problem areas which must be solved in order to enhance the cost effectiveness of the composite flexbeam tail rotors.

b. The solution: This project will develop filament winding manufacturing technology for fabricating flexbeam tail rotors. Techniques and processes which were not utilized during the R&D programs and which will be established during this proposed program include: (1) continuous filament winding from open to closed sections, (2) winding net contour shape versus reforming during final cure, (3) optimize tolerance control of structural and aerodynamic surfaces through improved tooling, and (4) improved resin control to ensure minimum weight components.

c. The end products: This program will support the application of composite materials to flexbeam tail rotors with reduced cost through automated fabrication, reduced parts count, and improved reliability and maintainability.

d. The implementation: The manufacturing processes, techniques, and tooling will be directly applicable to the YAH-64 with additional interchange and application to other rotary wing manufacturers and Government agencies by reports, briefings, and demonstrations.

e. Point of contact: Mr. L. Thomas Mazza or Mr. Dan Good, Appl Tech Lab, USARTL (AVRADCOM), ATTN: DAVDL-EU-TAS, Ft Eustis, VA 23604, AUTOVON 927-5732/4304, Commercial 878-5732/4304.

7. Economics:

a. This project is the first year of a 2-year MM&T program, totalling $2,235,000 (FY80 - $1,385,000 and FY81 $850,000).

b. R&D Task Proj No. 1F162208DB38 was performed in FY71-74 costing $775,000. This elastic pitch beam (flexbeam) concept is being used for the UH-60A tail rotor. Hughes is currently conducting R&D efforts on flexbeam tail rotor for YAH-64 with fullscale blade testing to be completed in FY79. This proposed project will provide advanced production filament winding technology to effect reduction in cost and improved reliability and maintainability.

c. A total discount acquisition cost savings of $2,770,284 for flexbeam tail rotors procured during FY82 through FY87 is estimated. (See Inclosure 1, Economic Analysis.)

d. The execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement.)

EXHIBIT P-16 (Part 1)

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT

RCS CSCRD-165 (R1)

Date: July 1978

Project No: 1807340

RECEIVED 5 JUL 1978

1. Project No.: 1807340   2. PA: 1497   3. Cost: $2950

4. Title: MM&T - Composite Main Rotor Blade

5. Facility/Contractor: Applied Technology Laboratory, USARTL (AVRADCOM), Ft Eustis, VA, and private contractor yet to be named.

6. Summary:

a. The problem: Current development and low rate production composite blade programs have not been oriented toward optimizing manufacturing techniques/processes related to blade configurations, fabrication methods, and improved structural reliability. Co-curing of the entire blade assembly in one operation is highly desirable for improved structural characteristics as demonstrated in the AH-1G/MTS development blade program; however, a number of problem areas were surfaced during the MTS and other blade programs which must be solved prior to a full production commitment. Specifically, (1) repeatable winding/forming techniques for the rectangular tubular spars, (2) better control of matrix percentage and fiber/matrix surface finish, (3) improved tooling to enhance dimensional tolerance and reduce component twist/warpage during curing, and (4) improved blade skin to spar and core bonding.

b. The solution: This project will develop filament winding manufacturing technology for fabricating MTS type composite main rotor blades. Processes to be established during the proposed program include: (1) soft/inflatable mandrels to wind spar tubes to net contour (rectangular) shape versus current uniform cylindrical shape while maintaining required flexible /noncured condition, (2) significant increase in fiber band width and improvement in uniformity during winding operation, (3) improved matrix control procedures to ensure weight limits, weight distribution and surface finishes to minimize debond/delamination areas, (4) balanced shell tooling to enhance outer blade contour and tolerance requirements, and (5) net shape winding of blade outer skin.

c. The end products: This program will support the application of composite materials to main rotor blades with reduced cost and improved field repairability.

d. The implementation: Manufacturing processes, techniques, and tooling will be directly applicable to the YAH-64 helicopter with additional interchange and application to other rotary wing manufacturers and Government agencies.

e. Point of contact: Mr. L. Thomas Mazza, Appl Tech Lab, USARTL (AVRADCOM), ATTN: DAVDL-EU-TAS, Ft Eustis, VA 23604, AUTOVON 927-5732/4304, Commercial 878-5732/4304.

7. Economics:

a. This project is the second year of a 3-year MM&T program, totalling $4,189,000 (FY79 - $739,000; FY80 - $2,950,000; and FY81 - $500,000).

b. R&D Task Proj No. 1F263211D641 was performed in FY74-77 costing over $1,800,000. This proposed project will provide advanced production filament winding technology for blades with reduced cost and improved operational life.

c. A total discount acquisition cost savings of $12,772,900 for composite main rotor blades procured during FY81 through FY87 is estimated. (See Inclosure 1, Economic Analysis.)

d. The execution of this project will not have a significant impact on the quality of the environment. (See Inclosure 2, Environmental Assessment Statement.)

IBIT P-16 (Part I)

DATE: 1 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

DUPLICATE

RECEIVED
5 JUL 1978

1. Project No.: 1807341 2. PA: 1497 3. Cost: $85

4. Title: Structural Composites Fabrication Guide

5. Facility/Contractor: U.S. Army Materials and Mechanics Research Center, Watertown, MA

6. Summary:

a. Problem: Application of composite materials to aircraft structures has experienced tremendous growth in the past ten years; a need exists for a data base to document industry experience in composites fabrication so that cost and manufacturing comparisons can be made.

b. Solution: The Structual Composites Fabrication Guide will provide information in a synergistic fashion to (1) provide production analysis, (2) provide process/cost interrelationships, and (3) promote a thorough manufacturing/engineering interface in the application of advanced composites.

c. End Products: This project will provide the Army input necessary along with the Air Force, Navy, and NASA for publication of a third edition of the Structural Composites Fabrication Guide.

d. Implementation: Technology gained from this project will be disseminated to industry and other government agencies by distribution of reports and presentation of briefings.

Project Engineer: S. W. Tozlowski, AMMRC, AV 955-3513.

7. Economics:

a. This project is a one-year effort totalling $85,000 (FY80 - $85,000).

b. R&D in support of this program has been performed by private industry.

c. Publication of the Structural Composite Fabrication Guide will provide government and industry with cost and production analysis for composites manufacturing techniques.

d. The execution of this project will not have a significant effect on the quality of the environment.

PROJECT NO. 1807341

EXHIBIT P-16 (Part 1) Date: 1 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

1. Project No: 1807342 2. PA: 1497 3. Cost: $150K

4. Title: MM&T - Pultrusion of Honeycomb Sandwich Structures

5. Facility/Contractor: U. S. Army Materials and Mechanics Research Center, Composites Division, Watertown, MA and private contractor(s) to be selected.

6. Summary:

a. Problem: Honeycomb Sandwich Panels are used extensively in composite airframe structure for applications such as flooring, stringers, box beams, and other structural applications. Fabrication of these structures is labor extensive and face to core bonding often takes two cure operations.

b. Solution: Continuous production of sandwich structures with honeycomb or other cores can be accomplished using pultrusion. Recent work by private industry using low cost ceramic pultrusion dies has shown the feasibility of pultruding honeycomb sandwich with woven broadgood facings, modified unidirectional facings, or combinations. This project will develop the manufacturing technology necessary for production pultrusion of sandwich structure for use in composite airframe fabrication.

c. End Products: This project will provide the necessary manufacturing technology necessary to fabricate tooling for production, specifications for a full scale automated process, and sandwich structures in a variety of materials and configurations for evaluation by Army Aviation contractors.

d. Implementation: Technology gained from this project will be disseminated to industry and other Government agencies by distribution of reports and presentation of briefings. Implementation will occur after successful evaluation of prototypes structures by Army contractors.

7. Economics:

a. This project is the first year of a two year effort totalling $250,000 (FY80 - $150,000; FY81 - $100,000).

b. R&D in support of this program has been performed by Boeing-Seattle.

c. The use of pultrusion for fabrication of aircraft sandwich panels will substantially reduce labor and cure times associated with traditional methods of sandwich manufacture.

d. The execution of this project will not have an adverse effect upon the quality of the environment.

EXHIBIT P-16 (Part I)

DUPLICATE

DATE: 1

RECEIVED 5 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS-CSCRD 165 (R1)

1. Project No: 1807344   2. PA: 1497   3. Cost: $300K

4. Title: MM&T - RIM Urethane Molding for Low Cost Secondary Structures

5. Facility/Contractor: U.S. Army Materials & Mechanics Research Center, Composites Division, Watertown, MA and private contractor(s) to be selected.

6. Summary:

a. Problem: Present methods of fabricating aircraft secondary structures (especially access doors) involve significant recurring labor and expensive materials. Current structures, fabricated from fiber reinforced sandwich panels and/or formed sheet metal often require complex assembly.

b. Solution: Develop a manufacturing process to produce these secondary structures from reaction injected molded (RIM) urethanes. This process is a low pressure molding technique which can utilize low cost composite molds resulting in manufacture of extremely cost effective structures. R&D efforts in this area have been performed by private industry. This project will develop prototype tooling and secondary structures for contractor evaluation.

c. End Products: This project will develop a manufacturing process specification and mold design data to economically produce secondary structural molded parts. Cost comparison data will be developed to verify cost savings.

d. Implementation: Technology gained from project will be disseminated to industry and other Government agencies by distribution of reports and presentation of briefings. Implementation will occur after successful prototype evaluation by the contractor. Project Engineer: S. W. Tozlowski, AMMRC, AV 955-3513

7. Economics:

a. This is the first year of a two year effort totalling $300,000 (FY80 - $150,000; FY81 - $150,000)

b. R&D effort supporting this project has been completed by private industry.

c. The proposed method of fabricating aircraft structures will reduce labor by 75 to 90% by eliminating subassemblies. In addition, weight reductions, insulation, good sound attenuation, and design flexibility benefits will occur.

d. The execution of this project will not have an adverse effect on the environment and does not violate safety standards.

PROJECT NO: 1807344

EXHIBIT P-16 (Part 1)

DUPLICATE

Date: 1 JUL 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS DSCAD 163 (R1)

RECEIVED 5 JUL 1978

1. Project No: 1807345 (AVRADCOM) 2. PA: 1497 3. Cost: $250

4. Title: In Process Control of Resin Matrix Cure

5. Facility/Contractor: Army Materials and Mechanics Research Center, Watertown, MA, and private contractor(s) to be selected.

6. Summary:

a. Problem: Conventional control of the cure stage during composite hardware manufacturing is attained through manual or automatic control of the autoclave/press temperature as a function of time. The particular time-temperature-pressure cycle employed is fixed as a result of previous processing and mechanical testing of coupon specimens. This method does not consider the chemical state of the resin during the cure which is dependent on: (1) prepreg room temperature out time. (2) variation in heatup rates due to thermal mass of tooling and multipart autoclave batch processing and, (3) batch to batch prepreg stoichiometry.

b. Solution: In process control techniques capable of monitoring the resin flow/cure behavior is needed to insure production of components having consistently high quality. In addition, the in process control technique must provide output signals which can be employed in a computer-controlled feedback loop for the control of autoclave/press conditions so that all parts are maintained within an acceptable cure envelope. Northrup IRAD efforts have shown that ion graphing is capable of providing the necessary information to a computer controlled cure system and this effort will develop the required software for the closed loop computer control of the autoclave/press process and demonstrate its applicability in curing composite helicopter structures.

c. End Products: The end products of this project will include the necessary software for closed loop computer control of composite curing methods and prototype tooling for process demonstration.

d. Implementation: The results of this project will be disseminated to the helicopter industry and other government agencies by means of technical reports and briefings. For additional information, point of contact is Mr. Stanley Tozlowski, AMMRC, AV: 955-3513.

7. Economics:

a. This project is a two year effort totalling $425,000 (FY80 - $250K; FY81-$175K).

b. R&D effort is being performed by Northrop Corporation under IRAD funds during FY78 and FY79.

c. The use of in-process control methods for composite materials will result in reduced costs of quality control, productivity, and part rejection.

d. The execution of this project will not adversely effect the quality of the environment (See Inclosure 1, Environmental Assessment Statement).

Exhibit P-16 (PART I) DATE: 1 June 1978

PROJECT ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

8152

1. Project No. 5801001 2. PA 4250 3. Cost $250

4. Title: MMT, "Pilot Line for Fuze Fluidic Power Supplies"

5. Facility/Contractor: Harry Diamond Laboratories (DELHD) 2800 Powder Mill Road, Adelphi, MD 20783
Contractors to be selected from qualified offerors.

6. Summary: a. PROBLEM - Proper operation of present design for fluidic generators, which are now being utilized as power supplies for a variety of rockets and bombs, depends largely on a complex geometrical configuration in which allowable dimensional deviations and interplay between component parts are extremely critical. In production, the requirement for close tolerance fabrication and assembly of precision parts is reflected in unnecessarily high manufacturing costs and low yield for those devices.
b. SOLUTION - The purpose of this project is to ~~identify and adopt~~ establish the most economical manufacturing processes and techniques available for the establishment of a mechanized pilot assembly line for the production of fluidic power supplies. This will include the design and fabrication of special dies for the stamping, forming and die casting of metal parts from alnico, steel and aluminum, special molds for the forming of plastics required for the manufacture of critical parts, and assembly techniques and fixtures that will reduce the cost and complexity of tedious assembly, adjustment and calibration processes prevalent in the R&D program.
c. END PRODUCT - A pilot line for the manufacture of selected parts, such as, ring nozzles, slotted collars, magnets and diaphragms as well as for assembly procedures and required fixturing for critical components. In addition, a complete manufacturing report, including drawings of all equipment will be prepared.
d. IMPLEMENTATION - The pilot line which will result from this project will, in itself, provide a limited production capability in support of the General Support Rocket System (GSRS). It will be further supplemented by production funds to build up production rate to levels required by the GSRS program. Technical point of contact for this project is Dr. Carl Campagnuolo, AV 290-3193.

7. Economics:
a. Costs:

	FY75	FY76	FY77	FY78	FY79	FY80	FY81
PEMA	0	0	0	0	0	250	250
R&D	35	50	35	35	0	0	0

b. Summary of economic analysis: Because of the classified character of the GSRS program, generator savings can only be stated for the total projected procurement. On this basis, an absolute savings of more than one million dollars is anticipated in the course of GSRS generator production as a result of this MM&T program and expenditure. When discounted according to each year of production, the savings calculate to 1.3 times the cost of the MM&T program. In addition, future savings can be expected from the 2.75" rocket and Navy programs.

c. Environments: The environmental consequences of this project have been assessed and the approved EIA, dated 5 April 1977 is attached. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

EXHIBIT P-16 (Part I)
8152

DUPLICATE

AK

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED
14 JUN 1978

1. Project No: 5801345 (ARRCOM) 2. OP: 5397 3. Cost: $458

4. Title: MMT: Mfg Methods and Tech for the Biological Warning System

5. Facility/Contractor: ARRADCOM, Dover, NJ/Bendix Environmental Sciences Division, Towson, MD

6. Summary:

a. The problem: The Biological Detector and Warning System, composed of the XM2 Sampler, the XM19 Biological Alarm, associated Refill Kits, and Remote Alarms, is the only item which can provide biological agent detection capability to the Army. A full and complete manufacturing methods and technology project must be completed on the item to minimize problems during production. The Biological Detector and Warning System presents unique, difficult, and challenging production engineering problems. The two major sub-systems, XM19 Alarm and the XM2 Sampler are complex, scientific instruments of sophisticated design. They involve scientific disciplines of aerodynamics, chemistry, electronics, and systems analysis, and require competence in mechanical, chemical, structural, and electrical engineering, and unusual aspects will dominate the production engineering effort.

b. The solution: Perform engineering studies of problem areas identified by a PEP to insure production processes that will bring about more readily reproducible and less costly components. Of particular concern are the tape and drive assembly, liquid system, electronic logic, refill kits, vibrating pumps, and sequencing solenoids. The areas most critical to success of the Alarm System are 1) the tape transport system, 2) wash station assembly and 3) the particle impactor. The producibility aspects of these areas are being addressed by the FY78 MMT 5781345. Producibility and source identification for 1) the premix solutions, 2) adhesive tape, and 3) fluid pumps are the primary subjects of the FY79 MMT project. Studies concerning manufacturing methods and 1) collector-concentrator, 2) wash station, 3) impactor, 4) reaction cell, and 5) electronic circuitry initiated in FY79 will be completed in this FY80 MMT. Additionally, in FY80 producibility studies of the following items will be initiated and completed: 1) tubing and fittings, 2) sealing, 3) cable crimping, and 4) thermal electric cooler heater.

c. The end products of this project are: The total program will result in a fully documented and proven manufacturing method for use in production, and an item of assured reproducibility, with a minimum of sole source items that can be acquired on a broader base.

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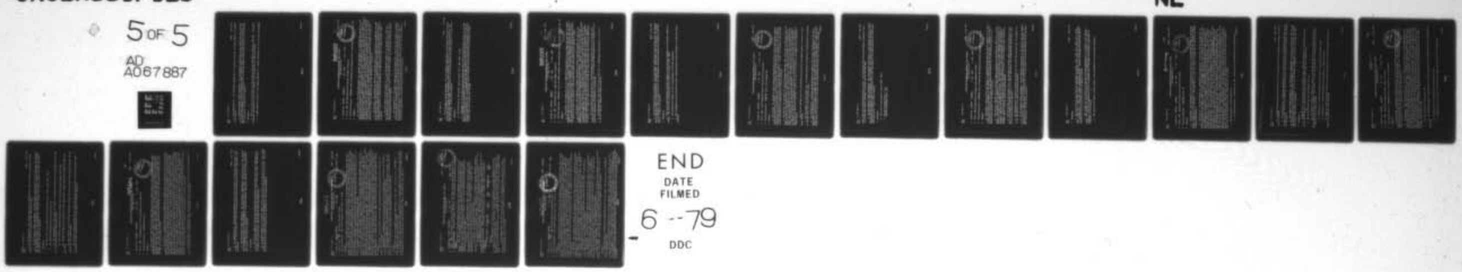

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d. The implementation. All information gained will be included in the TDP, and made available to prospective producers.

e. The Environmental Impact Assessment: The environmental consequences of the project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 22 March 1977 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,466 as follows: FY78-$480, FY79-$538, FY80-$458. Preceeding Government sponsored efforts for the biological alarm through FY78 for R&D are $24,160K.

b. An MMT project on items of such complex magnitude is a normal progression in the life cycle development.

EXH r P-16 (Part I)
8152

DUPLICATE

AK

DATE: 1 June 1978

RECEIVED
14 JUN 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804062 (ARRCOM) 2. PA: 4250 3. Cost: $1100

4. Title: MMT: Auto Manufacture Sys f/Mortar Increment Containers

5. Facility/Contractor: ARRADCOM, Dover, NJ/Indiana Army Ammuniton Plant, Charlestonw, IN Unknown Contractors

6. Summary:

a. The problem: This continuing project will complete the development of a manufacturing system for a new felted explosive propellant charge increment container for the 60MM (M204) and 81MM (M205) Mortar Ammunition. Manufacturing experience to date has been primarily in support of developmental needs and has been based on manual methods keyed to small quantities. Capabilities of the private companies can be expanded and at least partially automated in the course of future production. However, the manufacturing capabilities of the private companies are inadequate to meet the mobilization requirement Alternate II volume. The container costs are high and, to provide the manufacturing capability to produce increment containers at Alternate II volumes, the Army must take action to develop a production base to meet mobilization requirements.

b. The solution: This program will develop an automated system for manufacturing the 60MM M204 and 81MM M205 propellant charge increment containers. A complete Technical Data Package for an automated propellant charge increment container manufacturing process will be provided to the Army; enabling the Army to establish a production capability to produce these containers on a mass production basis at either private or GOCO facilities.

c. The end products of this project are: A pilot production system for the manufacture of 60MM M204 and 81MM M205 propellant charge increment containers, equipment drawings to complete this system as a prototype and procure additional systems, a complete Technical Data Package, hazards analysis, production qualification program and technical reports.

d. The implementation: Successful completion of this project will provide the Army a means of expanding the private industry procurement base for the 81MM M205 and 60MM M204 propellant charge increment containers and the capability to procure automated production manufacturing processes for these containers to meet mobilization requirements. The Technical Data Package developed from this project will be used to implement a broad procurement base for both GOCO plants and private contractors.

5804062

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $1,607; FY79 - $507, FY80 - $1100.

b. Development of the automated propellant charge increment container manufacturing process for the 81MM M205 and 60MM M204 mortar ammunition will provide the Army a means of achieving container production requirements at an economical cost. It is estimated that automation of the current process can provide a yearly cost savings of $23.4 million for the 81MM M205 increment container and $4.2 million for the 60MM M204 increment container which will provide a ROI of 230%.

EXI T P-16 (Part I)
8152

DUPLICATE

BH

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804190 (ARRCOM) 2. PA: 4250 3. Cost: $384

4. Title: MMT: Molding Rear Seal, 120mm FRG, APFSDS, Projectile.

5. Facility/Contractor: ARRADCOM, Dover, NJ; TECOM, Aberdeen, MD; Flinchbough Products Incorporated, Red Lion, PA

6. Summary:

a. The problem: The 1200mm FRG, and the 105MM XM774 projectiles utilize a rubber-like rear seal to prevent propellant gas flow past the projectile base. The present Technical Data Package (TDP) mandates that the seal be molded in place after assembly of the projectile components. This process requirement does not lend itself to high speed mass production techniques because of excessive manual labor and extremely complex molding processes. The mandated processes also generate an OSHA problem which metal parts plants are not euipped to handle.

b. The solution: This program will examine techniques to attach a separately molded rear seal to the assembled projectile unit without affecting ballistic performance. The plan of attack is to contract for manufacture of the rear seal with an independent molder of rubber products. This will transfer the OSHA problem to a producer equipped to handle it. Various means will be evaluated to attach the molded rear seal to the projectile assembly such that intimate adhesion is attained. Laboratory tests will be conducted to determine the optimum candidate process for qualification firing by TECOM. This project will eliminate an expensive bottleneck in the 120mm and 105mm production lines and will reduce facilities costs in follow-on PEM projects.

c. The end products of this project are: The end products of this project will be an acceptable mass production process for installation of the rear seal on the 120mm and 105mm projectiles and a reduction in the facilities requirement for production of this round.

d. The implementation: The results of this project will be implemented by modification of the T.D.P. of the FRG 120mm and 105mm XM774 APFSDS projectiles.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 April 1978, are available. No significant environmental impact is anticipated nor any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. There are no past Government sponsored efforts as this round was developed in the Federal Republic of Germany. The total cost of this project will be $384 as follows: FY80 - $384

b. This project will result in a per round savings of $1.25 per projectile.

c. The performance of this project will have no adverse effect on the environment or violate any safety standards.

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 5804258 (ARRCOM) 2. PA: 4250 3. Cost: $215

4. Title: MMT: Solar Ponds/Heat Pumps to Deliver Hot Process Water

5. Facility/Contractor: ARRADCOM, Dover, NJ; Riverbank AAP

6. Summary:

a. The problem: The heating of metal cleaning and phosphating solutions at metal parts plants consumes significant quantities of energy. A demand of 30,000 pounds of steam per hour for one (1) line is typical to maintain heat in the process solutions. The use of fuel oil, gas or resistance heating is not only becoming increasingly expensive but draws upon our dwindling energy supplies. A means of delivering hot process water without consuming scarce energy supplies is clearly indicated.

b. The solution: By utilization of newly developed technology, solar ponds used in conjunction with heat pumps can deliver hot process waters or superheated steam. The basis for this concept is to collect solar energy at the low temperature of about 100° F and then boost the temperature through a high temperature heat pump. This process permits the use of low cost shallow solar ponds as the solar collector which can operate at high efficiencies at the low collection temperature. Considerable research has been done by Government and industry to develop this technology to the point of commericalization. This project will demonstrate the feasibility of using solar technology to deliver hot water at a fraction of the energy cost of conventional energy sources.

Once the cost savings are proven the manufacturing facilities can submit projects to convert to solar water heating.

c. The end products of this project are: A prototype hardware installation at Riverbank AAP for supplying hot process water and a final technical report.

d. The implementation: Following the demonstration of technical and economic feasibility of the prototype hardware a determination will be made of the plant's overall hot water process requirements and a project submitted to provide the required equipment which would replace the plant's existing boilers. Using the technology acquired by this project, other metal parts manufacturing facilities will be examined to determine

where other solar installations should be made. This technology should prove particularly attractive to new facilities where capital investment in boilers has not yet been made.

6. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 17 March 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. Total cost of this project is $215 (FY80 - $215)

b. Savings/Investment Ratio = 2.32
Return on Investment (ROI) = 29%

5804258

EXHI P-16 (Part I)
8152

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 5804281 (ARRCOM) 2. PA: 4250 3. Cost: $1220

4. Title: MMT: Conservation of Energy at Army Ammunition Plants

5. Facility/Contractor: ARRADCOM, Dover, NJ/various GOCO Ammunition Plants/Contractors to be selected

6. Summary:

a. The problem: Concern exists that energy, in appropriate quantities, may not be available in the future to meet mobilization requirements at Army Ammunition Manufacturing and Loading Plants. Therefore, to insure mobilization requirements can be met, energy conservation measures must be identified and applied to the manufacturing processes of the ammunition plants.

b. The solution: Methods for more efficient energy utilization at Army Ammunition Plants will be determined. These measures will be immediate or short-term applications of current technology to the various industrial processes at Army Ammunition Plants. This effort will also determine technology requirements as it relates to explosive and propellant operations where immediate or short-term technology is not considered adequate. Efforts will be conducted to develop advanced technology in discrete segments based on potential economic payback to develop energy conservation methods.

c. The end products of this project are: This program will produce energy inventories/balances of specific unit processes, technical reports on the various subprojects, and recommendations stating where, what, and how much energy can be conserved.

d. The implementation: Economic analyses and design data for technology projects will be furnished concerning implementation of proposed conservation measures.

e. The Environmental Impact Assessment: The environmental consequences of this project have been assessed and the approved results of the Environmental Impact Assessment (EIA), dated 1 July 1976 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $5,633 as follows: FY75 - $191, FY76 - $875, FY77 - $1000, FY78 - $1062, FY79 - $1285, FY80 - $1220. Additional funding will be required for construction and equipment for implementation of identified energy conservation measures. However, an estimate is unavailable due to numerous and varied applications within the ammunition plants.

b. Cost savings will be realized by a reduction in energy expenditures on a process or unit operation basis. Such savings will only be realized when the final recommendations of this project are in fact implemented. The cost of application can not be estimated due to the number and variety of operations investigated by this project.

c. This project will have no adverse effect on the environment nor violate safety standards.

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EXH. P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6807940 (ARRCOM) 2. PW: 3297 3. Cost: $120

4. Title: MMT: Synergistic Platings with Infused Lubricants

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: The development of rapid fire weapons has resulted in increased wear to many of the moving parts. Present dry film lubricants as well as greases or oils tend to wear off with use and, therefore, require frequent reapplication or reservoirs. Such maintenance or built-in reservoir systems are not practical solutions to many weapon systems:

b. The solution: The establishment of a synergistic plating process can provide coating systems with improved resistance to corrosion, reduced friction and permanent lubricity. Such a process is desirable but cannot be applied to weapon systems until the Army establishes a manufacturing process which can be used at Government installations or supplied to contractors. These platings are electrodeposited and electroless metallic coatings (generally nickel or chrome-nickel alloys) characterized with extreme porosity. The porous condition enables the subsequent infusion of lubricants (fluorocarbon polymers or molybdenum disulfide) by a controlled heat-treatment cycle. These coatings would improve friction resistance and increasse the wear life of many moving parts in rapid fire weapon systems. This project would immediately replace silver plating, a costly short supply material with inadequate wear resistance, on rotor tracks of the M61A1, M168 and other 20-30MM cannons. Other applications include the bolt body and barrel extension on the M85 and M219 mahcine guns, the M16 bolt body and the M60 operating rod and bolt. A two-year effort is expected to accomplish the necessary task. The FY80 effort will examine the application and characteristics of porous nickel and alloy electrodeposits to various types of ferrous surfaces. These deposits will then be subjected to controlled infusion of lubricants such as fluoro-carbon polymers or molybdeum disulfide. The FY81 effort will continue the evaluation of the synergistic process. The processes which yield the best results will be applied to the bolt and bolt carrier systems of small arms and a manufacturing process description will be prepared.

c. The end products of this project are:

(1) An engineering report containing test data, evaluation and recommedations for implementation.

(2) A manufacturing description applicable for use in production and as a reference for design and quality control personnel.

d. The implementation: Technology implementation will involve transfer of methodology established in the project to Army, other DOD and industrial facilities through specification modifications, technical consultations, and assistance.

e. Environmental Impact Assessment: The environmental consequences of this action have been assessed and the approved results of the Environmental Impact Assessment (EIA) dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $240K as follows: FY80-$120K, FY81-$120K. Implementation to production facilities will require an additional $70,000 in FY82 (PEM, Prod. Support, PIF).

b. The benefits resulting from this project will be:

(1) An economic analysis (Inclosure 2) shows a cost savings of $604,100 over a 10-year period and a ROI of 38% based only on a singular weapon system. Further cost savings can be realized when the new process is applied to other weapon systems.

(2) Elimination of costly bearing materials as silver or gold which are in short supply.

(3) Elimination of frequent maintenance and application of spray lubricants.

(4) Improved friction and wear resistance of weapon components will reduce spare part inventory and results in significant cost reductions.

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EXHIBIT P-16 (Part I)
8152

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No: 6808001 (ARRCOM) 2. PW: 3297 3. Cost: $130

4. Title: MMT: Rapid Flow Plating of Small Caliber Gun Tubes

5. Facility/Contractor: ARRADCOM, Dover, NJ/Contractor to be selected.

6. Summary:

a. The problem: Conventional chromium plating of gun tubes is extremely inefficient; requiring long process times and requiring excessive electrical and heat energy consumption. Small caliber gun tubes whose lengths are beyond five feet usually require special deep plating tanks thus involving deep pits, high bay and crane facilities as well as large consumption of bath solutions.

b. The solution: Rapid chromium plating of ID small caliber gun tube surfaces can be accomplished with high current densities under high solution flow conditions. Anticipated increases in deposition rates are 20 to 30 times that for conventional chromium plating. Higher efficiencies (300% increase in current efficiency and 40% reduction in heat dissipation) can be obtained with this method. This project will essentially implement the process established under PN 6777213 and 6797213 for large caliber tubes to the small caliber gun barrels. The FY80 effort will design and evaluate stationary anodes for rapid plating of small caliber gun tubes. Both vertical and horizontal modes of tube-anode position during plating will be examined. Evaluation of anode characteristics (material, configuration, taper) and various flow rates and current densities will be accomplished. The FY81 effort will establish and implement prototype production plating processing of gun tubes in the range from 5.56mm to 30mm.

c. The end products of this project are:

(1) An engineering report containing data, process procedures and recommendations for production implementation.

(2) A pilot plant for processing small caliber gun tubes.

(3) Recommendations for design and specification changes when this process is implemented.

d. The implementation: This project comprises the implementation phase to provide a production process capability for rapid flow plating of small caliber gun tubes.

e. The Environmental Impact Assessment: The environmental consequences of this action have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The total cost of this project will be $270 as follows: FY80 - $130, FY81 - $140.

b. The benefits resulting from this project will be:

(1) The establishment of the process will result in significant reductions in processing time and cost for chromium plating small caliber gun tubes.

(2) The projected ten-year discounted savings are $1,438,000 and the computed ROI is 82%.

(3) Greater savings are anticipated for other small caliber weapon systems and components other than gun tubes.

(4) Less exposure to the hazardous hexavalent chromium by the operation is anticipated because the new process will be a closed system.

(5) Provide a readiness capability for mass producing gun tubes without resorting to massive reestablishment of large plating facilities in the event of a military emergency.

EXh. .T P-16 (Part I)
8152

FA

DUPLICATE

DATE: 1 June 1978

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

RECEIVED 14 JUN 1978

1. Project No: 6808004 (ARRCOM) 2. PW: 3297 3. Cost: $120

4. Title: MMT: Co-Deposition of Solid Lubricants During Anodizing

5. Facility/Contractor: ARRADCOM, Dover, NJ

6. Summary:

a. The problem: Numerous military applications involve aluminum alloys to take advantage of their high strength-to-weight ratios. These alloys need anodized coatings for corrosion resistance, wear resistance and non-reflective surfaces. However, under sliding contact of the anodized surfaces, siezing or galling occurs. Temporary solutions to this problem can be made by applying solid film lubricants to the mating surfaces by spraying. But, since this is only temporary, galling quickly reoccurs when the solid film breaks down or is not adherent to the anodized surface.

b. The solution: A process which involves deposition of charged lubricant particles such as Teflon during hardcoat anodizing will provide low friction surfaces with improved abrasion, moisture and corrosion resistance. This process when applied to aluminum components could resolve the problem associated to galling and siezing. Unlike conventional solid film lubricants which lie on top of the metal and adhere by mechanical means, these coatings become an integral part of the substrate. Therefore, permanent lubricity, reductions in friction by 80% and extended service life would be realized with the co-deposited coating. Applications include the bearing surfaces on the rotating mechanism of the XM198, 155mm howitzer which require frequent application of lubricants. Mating surfaces in the M16A1 rifle and future weapon systems would also be provided with increased corrosion resistance. A two-year effort is expected to accomplish the necessary work in this project. The FY79 effort will evaluate various lubricant particles incorporated in the hardcoat surface, including molybdenum disulfide, alumina-tungsten disulfide polyethylene, and fluor-carbon polymers (i.e. Teflon). The FY80 program will establish selective processing procedures and compatible coating systems for ordnance components.

c. The end products of this project are: The end product will be a manufacturing description applicable for use in production and as a reference for design and quality control personnel.

d. The implementation: Technology implementation will involve transfer of methodology established in the project to all DOD and commercial facilities through specification modifications, technical consultation, and assistance.

e. The Environmental Impact Assessment: The environmental consequences of this action have been assessed and the approved results of the Environmental Assessment (EIA), dated 1 April 1978 are available. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. An EIS is not required.

7. Economics:

a. The private industrial section has developed the systems but no application to weapon components has been made. The total cost of this project will be $240 as follows: FY79 - $120, FY80 - $120. Implementation to production facilities will require $50,000 (PEM, Prod Support PIF).

b. An economic analysis for the M16A1 upper receiver alone shows a ROI of 46% and a discounted cost savings of $707,500 over a 10-year period based on salvaging worn receivers and extending the service life. Additional savings could be realized by extending the application to other weapon components.

DUPLICATE

EXHIBIT P-16 (Part 1)
8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

DATE: 1 Jun 78

1. Project No: 6808017 (ARRCOM) 2. PW,A 3297 3. Cost (Thous): $171

4. Project Title: MM&T: Pollution Abatement Program

5. Facility/Contractor: Rock Island Arsenal, Rock Island, IL 61299

6. Summary:

a. Problem. Environmental pollution standards as related to the manufacture of armament systems are under constant scrutiny. Many of the current manufacturing processes at RIA are in jeopardy of being shut down due to changes that have been made in regulatory standards. A recent survey by the U.S. Army Environmental Hygiene Agency of the Plating Shop area has revealed a serious problem in the handling and disposal of cyanide wastes from the plating operations. Additionally, an evaluation of air emissions from several manufacturing operations at RIA (e.g. toxic vapors from rubber compounding and smoking lubricants from machining) has shown the quality of air to be poor, presenting a possible hazard to manufacturing personnel.

b. Solution. This project provides for an integrated plan of action of pollution abatement efforts in conjunction with the manufacture of armament components at RIA. The Pollution Abatement Program is divided into two separate tasks. The first task will address the problem of the polluting cyanide baths (e.g. copper cyanide, cadmium cyanide and cyanide alkaline derust). This initial effort will have been conducted in FY78 and 79 to replace these cyanide baths with non-polluting non-cyanide baths. Commercially available non-cyanide baths for cadmium and copper plating and alkaline derusting will have been evaluated and recommended for substitution. The second task (FY80) will address the quality of air in machining and forging operations and the rubber compounding processes. "Smokeless" lubricants will be evaluated for replacing the present high emission lubricants used in machining and forging operations. To reduce toxic emissions in rubber compounding operations, several processing parameters will be evaluated (e.g. carbon black pellets as a substitute for presently used carbon black powders) to improve air quality.

c. End Products. The end product will be several new manufacturing process descriptions improving the quality of air and water.

d. Implementation. Implementation of the end products will be accomplished in the conduct and completion of the recommended projects required to maintain future safety and health standards.

e. Environmental Assessment. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. A written EIA is unnecessary since environmental quality will be improved.

7. Economics:

a. There have been no preceding Government R&D efforts of this scope. The project cost is $82,000 for FY78, $42,000 for FY79 and $171,000 for FY80.

b. Benefits will result from the ability to maintain full capacity production uninterrupted as more stringent pollution standards for production are anticipated and solved. A justification for exemption to economic analysis is applicable for this project under provisions of para. 1-3d(3), AR 11-28 (See Incl, page 1-1).

EXHIBIT P-16 (Part I) DATE: 1 June 1978

8152

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165 (R1)

1. Project No.: 6808026 (ARRCOM) 2. PA: 3297 3. Cost: $141

4. Title: (MM&T) Application of Synthetic Quenchants to Gun Tubes and Heavy Weapon Components

5. Facility/Contractor: Watervliet Arsenal, Watervliet, N.Y./Benet Weapons Lab and unknown contractor(s).

6. Summary:

a. The Problem: Quenching mediums for large alloy steel components consist primarily of water and oil. Often these quenchants are not satisfactory from both the thermal phenomena and the safety standpoint. As a result, problems such as incomplete transformation, cracking, distortion, residual stress, occasional fires and noxious fumes frequently occur. Current manufacturing technology has not significantly alleviated this problem.

b. The Solution: Recently, polymeric materials have become available that are water soluble and favorably influence the heat transfer properties of that quenching medium. These additions alter the quench power of the bath and allow the heat treater to obtain a range of cooling rates while eliminating the hazards associated with oil quenching.

c. End Product: The end product will be a comprehensive technique to quench components, generally requiring oil, in water based synthetic quenchants. Prototype parts will be available for testing and service.

d. Implementation: There will be no additional cost for implementation of this project.

e. Environmental Impact Statement: The environmental consequences of this project have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, an Environmental Impact Statement (EIS) is not required.

7. Economics:

a. Funding Program:

Preceding R&D	Prior FY	FY80	Implementation	Total
$0	$0	$141	$0	$141

b. Benefits:

(1) Quantifiable: The application of synthetic quenchants to gun tube components will result in a reduction of rejections due to the variety of heat treatment related problems mentioned in 6(a). The net result is a substantial savings based on the items listed in Para8. The economic analysis of this project reveals production savings of $313,000 and mobilization savings of $2,952,155 during economic life.

(2) Non-Quantifiable: The use of synthetic water base quenchants rather than oil will have a two-fold benefit. First, the nuisance and safety hazards of oil quenching will be eliminated and second, a petroleum product will be conserved.

EXHIBIT P-16 (Part 1)
8152

DUPLICATE

PRODUCTION ENGINEERING MEASURES (PEM) PROJECT
RCS CSCRD-165(R1)

DATE: 1 Jun 78

RECEIVED 9 JUN 1978

1. Project No.: 6808030 (ARRCOM)　　2. PW,A 3297　　3. Cost (Thous): $100

4. Project Title: MM&T: Manufacturing Guide for Elastomeric Seals

5. Facility/Contractor: Rock Island Arsenal, Rock Island, Illinois 612[illegible]

6. Summary:

a. Problem. Currently there are only one or possibly two manufacturers of non-metallic seals that can meet the rigid Military requirements for compression set, oil swell and low temperature flexibility required on seal drawings. The formulations for these seals are proprietary and cannot be used by other suppliers. When the sole source company or companies have a breakdown in manufacturing equipment or other problems, needed seals cannot be supplied to the field. Problems are occurring in the procurement and use of quad-seals, T-seals, O-rings, etc. for several weapons systems, i.e., M-140, M-127 and M-198. Malfunctioning of seals can cause excessive repair down time not only for simple replacement but also due to damage to recoil parts, i.e., galling of cylinders etc.

b. Solution. This program will address the elimination of sole source procurement by documenting processing techniques and formula variations for a variety of Military seals for publication into a guide for use by the rubber industry. Data would define seals by procurement nomenclature and give compounding data, i.e., techniques, and/or formulas to meet drawing requirements. The net effect would be elimination of sole source procurement with a resultant reduction in cost and ease of procurement of Military non-metallic seals.

c. End Products. This program will provide a Manufacturing Guide for the procurement of non-metallic seals based on rigid Military drawing requirements.

d. Implementation. Results of this program, a manufacturing guide for Military seals, will be implemented at Rock Island Arsenal and at other installations requiring purchase on non-metallic seals. The findings (including laboratory evaluations of compounding, molding and curing) will be fully utilized to assure that a cost effective, broad procurement base is acquired for the purchase of non-metallic seals. The manufacturing guide would be a standard part of the procurement documents package.

e. Environmental Assessment. The environmental consequences of this action have been assessed. No significant environmental impact is anticipated nor is any environmental controversy expected to be associated with this action. Accordingly, there is no need to prepare a written Environmental Impact Statement.

7. Economics:

a. There have been no preceeding Government R&D efforts of this scope. The project cost is $100,000 for FY80 and $85,000 for FY81.

b. An economic analysis per Format B, Incl 1, has been prepared. Dollar quantifiable benefits are difficult to ascertain since this project is based primarily on broadening the procurement base for purchase of seals. Out of the hundreds of different types and sizes of seals purchased by the Government, one type (FSN-1015-169-1785) costs $200,000 per year. Open competitive bidding and a processing guide will lower the cost of this and other seals by broadening the procurement base from one or two to at least 20 bidders resulting in cost reductions of at least 25 percent.